EDITORIAL

HAVE you bought a Liberty Bond and joined the Red Cross?

POTASH as a by-product of portland-cement manufacture is being produced by the Santa Cruz Portland Cement Company at its plant at Davenport, California.

DELEGATIONS from almost every industry are in Washington protesting to Congress that their particular line of activity will be specially burdened by the proposed war-taxes. Which seems to us to indicate that the measure in general is an equitable one.

The Liberty Loan

There is but one way for a nation to win a war, and that is to fight, fight hard, and fight with all its resources and the utmost efforts of every one of its citizens. To a comparatively small number of us will come the opportunity to get on the firing line. Others will minister to the sick and wounded behind the lines, and still others will take part in repairing the devastation in the reclaimed and liberated area that has been in the war-zone. A much larger number will be occupied in the production and transportation of munitions and supplies for our own army and those of our allies.

Yet all these activities are entirely dependent upon one thing—money. Part of that money will come from taxes, taxes that we will all feel, and all have to pay, let us hope with a minimum amount of grumbling. But taxes will not be sufficient to carry on the War. Congress has authorized $7,000,000,000 in bonds, and the Government has now placed a $2,000,000,000 issue, 'The Liberty Loan,' on the market.

Here, then, is the opportunity for us all to do our part in the struggle to wipe autocracy off the earth. The bonds are issued in amounts at low as $50, the amount of the first payment is nominal, and the subsequent payments are spread over a period of three months. Furthermore, there are several private agencies that are in a position to arrange still easier terms of payment. It hardly seems as if there can be any able-bodied person who cannot manage to take at least one $50 bond.

The arrangements for the loan have been such that the least possible disturbance to business will result. The money will remain with the bank that took the subscription until it is actually paid out by the Government for supplies or wages, usually in the same locality. This is going to prove a stimulus rather than a check to business.

While the purchase of one or more Liberty Bonds is a patriotic duty, it is also a good investment. Although the rate is only 3½%, if exemption from taxation, convertibility, and other features are considered, these bonds compare favorably with other first-class securities. Furthermore, the Government has announced that in case it becomes necessary to issue securities at a higher rate of interest before the end of the War, these bonds will be convertible into such securities.

Great Britain has less than half the population and resources of the United States, yet the Government there has recently floated a new loan of £1,000,000,000. This makes the total amount of war loans nearly £2,000,000,000, and the total debt over £3,000,000,000. In other words, the debt of Great Britain per capita is now over ten times what the debt of the United States per capita will be after the Liberty Loan is subscribed. And all the money raised by the loan will be spent in this country, while a considerable part of the British debt was incurred for supplies purchased in the United States.

There is little doubt that the loan will be fully subscribed, but it is important that it should be considerably over-subscribed, for two reasons. First, is the fact that this is the war of the American people, and all of the people should have a part in it. It has been announced that in case of an over-subscription, the smaller subscribers will be served, so the larger the over-subscription the greater the number of bondholders. Second, a large over-subscription will do more to encourage our allies, who are bearing our burden, and discourage our enemies than anything else we can do at this time.

If you have not already bought a bond, take the blank that appears on page 10 of the advertising section and subscribe for as many bonds as you can possibly afford.

The Oil Situation

If the proverbial man from Mars were to come to California and find that the Nation is engaged in a war that will certainly be the most costly in money and possibly in lives that we have ever experienced; that the stored supply of the only available fuel for a large number of railroads and industries of vital importance in the conduct of the War is dwindling rapidly; that large areas of land producing this fuel are still available, but that their development is prohibited by the Government because of the possibility of interference with the hypothetical requirements of the Navy in the distant future; if he learned all these things and a few others too numerous to mention, we believe that he would be even more mystified than the oil-operators of California by the actions of certain officials of the Federal Government.

With the rights and wrongs of the Southern Pacific land-cases we have no concern. This is a question that is being investigated by the Courts, slowly and carefully as

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such an important matter should be. Whatever the final decision, no one doubts that the Southern Pacific Company is financially responsible, so that the Government's equity is protected. But at present the Southern Pacific system is just as much in the service of the Government as if it were actually being operated by Federal officials, except that it is probably being operated more efficiently than if such were the case. It is almost as important to the conduct of the War that the railroads should have oil for present needs as that the Navy should have oil for present needs, certainly a great deal more important than that the Navy should have oil in, say, 1922 or 1923. This in addition to the fact that the engineers of the United States Geological Survey have reported that there is enough petroleum in the oil-shale deposits recently withdrawn in Colorado and Utah to last the Navy for at least one hundred years.

A similar line of reasoning applies to the unpatented withdrawn land, both undeveloped and partly developed, except that few of the operators are as strong financially as the Southern Pacific Company. Nevertheless, it ought to be possible to arrange for the development of this land, either directly by the strong companies or by these companies guaranteeing the responsibility of the smaller operators. Such development could be carried on under sane restrictions as to line-drilling and well-spacing, and like all other development in the State, would be subject to the supervision of the State Mining Bureau as regards water-infiltration measures. While only a comparatively small part of the withdrawn area needs to be drilled at the present time, it should be remembered that there is a shortage of skilled labor, casing, and nearly all of the other essentials for drilling. Opening the withdrawn land to development under reasonable restrictions would permit the selection of territory that would return the maximum of oil for the minimum of material and labor.

Those of us who have lived through an 'oil-boom' in new territory have been struck by the fact that, however strong the rivalry might be between two companies that were trying to acquire title to the same land, as soon as the fire-whistle sounded, everything else was forgotten in the effort to defeat the common enemy. The world is on fire and the oil-operators of California are doing their part to put out the conflagration. Cannot the Government do the same?

Hours of Labor and Maximum Output

It was two years and eight months after the invasion of Belgium before war was declared by the United States. There is room for an honest difference of opinion as to whether or not this was too long a period. Be that as it may, one result of this delay should be that the mistakes that we shall make from now on should not, at least, be the same kind of mistakes that our allies have already made and discovered.

One of the mistakes that the British have found was the assumption that longer hours of labor necessarily meant increased production. A summary of reports made by a committee appointed to investigate both hours and conditions of labor in munition-factories appears in another column.

That there is a certain limit beyond which increased hours brings little or no increase of production is well known, and it is almost as well known that this limit varies with different industries. However, there has been comparatively little real investigation of what these limits are. There are a number of laws limiting the hours and conditions of labor of women and of minors, but, excellent as most of these laws undoubtedly are, they have been inspired more by sentiment than by scientific investigation, and, in any case, the great body of workers has not been affected. It hardly needs to be stated that the work of the labor unions in regulating the hours of labor has not been the result of a desire for maximum output.

While the report deals with munition-factories only, many of the conclusions are applicable to other factories, and even to work outside factories, such as food production. It is generally admitted that success in the War is largely dependent on the employment of every citizen in useful occupations under conditions that will insure his working at the highest efficiency. That some of the labor-union regulations upon hours must be discarded in order to attain that end is evident, but such action should not be taken until a careful investigation of the particular industry has been made by people who know.

Apparently the tendency in Great Britain has been to operate factories with two shifts of from 10 to 12 hours each, rather than three 8-hour shifts. In fact some of the committee's objections to a night-shift are not applicable where 8-hour shifts are worked.

The shift system, which was somewhat grudgingly recommended by the British committee, might be employed in handling both construction and farm work. While there is a tendency toward exaggeration in some quarters, there is no question that there is a shortage of labor to produce all the things that we and our allies' need. It has been suggested that this shortage can be met by the use of labor-saving machinery wherever possible. Here again we are confronted with the fact that there is not enough machinery to go around, provided, that is, the machinery is being used only part of the day. If, however, the machinery is in use 24 hours per day, a great deal more can be accomplished. Time was when the question of lighting made most outdoor night-work impracticable, but now the cost of lighting the job is usually comparatively small. In summer the greater efficiency during the cooler part of the 24-hour period sometimes more than compensates for the cost of lights. It is also true that in the not far-distant past, a great deal of machinery was of such a character that it had to be tinkered for a good part of the night in order to make it run at all the next day, but that is seldom the case now. A number of contractors and farmers are now using either two or three 8-hour shifts on their work, and we believe that it will be well for men in both callings to study the question carefully.

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REVIEW OF THE MONTH

THE high cost of living affects the railroads as much as the average citizen, possibly more. The cost of locomotives has increased 75% in the past two years, the cost of passenger-cars 50%, the cost of freight-cars 60 to 85%, while smaller machinery and other materials show increases of cost ranging from 50 to 300%. At the same time the demands upon the railroads are increasing all the time, requiring the purchase of new equipment, no matter what the expense may be if they are to continue to operate. Shippers are bringing suits for alleged damages resulting from failure of a railroad company to provide cars when requested. While some of these suits may have a sound basis, it is probable that in most cases, the railroads would have been only too glad to provide cars, if they could get them.

TO add to the railroad companies' troubles, every year bills are introduced at one State legislature or another compelling unnecessary increases in operating or other expenses. Most of these bills provide either for increased train-crews or for a reduction in the number of cars in a train. Bills were recently introduced in Oregon limiting the number of cars in a train, and in California requiring an additional flagman on all trains that load or unload freight or pick up or set out cars at two or more stations en route. It is estimated that this latter requirement alone would have, if adopted, either increased the cost of handling freight $500,000 per year, or else compelled a large reduction in service to the public.

MEETINGS of technical societies of all kinds are being considerably disarranged on account of the War. The spring meeting of the Portland Cement Association, which was to have taken place at San Francisco in April, was postponed indefinitely. The National Electric Light Association had prepared an elaborate and interesting programme for its annual convention, which was to have been held at Atlantic City, May 28 to June 1. However, soon after war was declared, it became evident that co-operation with the Federal Government was the most important matter for discussion and that this co-operation could best be attained by an earlier and shorter meeting of the Association. Accordingly, a meeting of class A and class D members was held in New York on May 9 and 10, only the most necessary topics being considered, many of the papers and reports being read by title only. Now comes the American Society of Civil Engineers with a complete abandonment of its annual convention, which was to have been held at St. Paul and Minneapolis, June 12 to 15. Many of those who would otherwise have attended the convention now find their time completely occupied with one branch or another of war activities, and to hold the convention under these circumstances has seemed inadvisable.

HIGHWAY construction on the Pacific Coast seems, if anything, to have been stimulated by the War. The Washington State Highway Commission received bids for the construction of 100 miles of highways during April and May, and more work is to be started before the end of the season. Several of the counties are also building improved roads. As we go to press, the campaign in Oregon on the proposed $6,000,000 bond issue for a State highway system is drawing to a close. Meanwhile several counties are at work on highway systems. The California State Highway Commission has been delayed somewhat this year by the fact that the money from the $15,000,000 bond issue that was voted last November will not become available until July. Nevertheless bids for the construction of 44 miles of highway were opened in May, with the understanding that no money will be available for payments to contractors until August 15. More bids are to be opened in June, and a good start toward completing the State highway system will be made this year.

THE principal county activities during this season will be in Stanislaus, Sacramento, and Tulare counties. In Stanislaus county nearly all the highways proposed under the $1,482,000 issue voted last October are now under construction. In Sacramento county, contracts have been awarded for the construction of between 30 and 40 miles of the 124 miles of the proposed county highway system. Bids are to be received in Tulare county early in June for the first 50-mile unit of the proposed highway system of 220 miles. Incidentally it might be remarked that California in general and the State highway work in particular is serving as a school for the training of highway engineers for service in other parts of the country. Several former employees of the State Highway Commission are now with the United States Office of Public Roads and recently Mr. R. K. West has been appointed State highway engineer for Nevada.

FEDERAL aid for highway construction during the continuance of the War will be extended to military roads rather than to those of purely scenic interest. On the Pacific Coast; the road that the Government is most desirous of completing is the so-called Pacific highway, extending along the entire coast, but at a sufficient distance inland to protect it from sudden attack from

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the ocean. The War Department requests that military roads shall have a smooth hard surface of broken stone or some durable kind of pavement not less than 20 feet wide. Bridges are to be of steel or masonry and capable of supporting a six-inch howitzer, 3000 pounds on the front wheels and 6500 pounds on the rear wheels, distance between axles 12 feet, width of wheel-track 5 feet, or a four-ton truck loaded, 6000 pounds on the front wheels and 8000 pounds on the rear wheels. This is a loading slightly heavier than Cooper's D for highway bridges. The highway surface, necessarily, must be capable of supporting the same loads. Grades should not exceed 5% except for short stretches of less than 150 feet, and should in no case be greater than 10%. In hilly country where the natural road foundation is of rock or hardpan, artificial surfacing is of less importance than the completion of a well-drained roadbed on an easy grade, and it is permissible to leave the surfacing until a later time.

THE authority of a county purchasing agent acting under proper requisition to purchase supplies without asking for bids has recently been sustained in the Superior Court of Stanislaus county, California. At the request of the Board of Supervisors, the county purchasing agent obtained bids for furnishing corrugated culverts by writing to three manufacturing companies, instead of advertising. The contract was awarded to the bidder recommended by both the purchasing agent and the county surveyor, but not to the lowest bidder. A taxpayer of the county brought suit against the Board of Supervisors, the auditor, treasurer, and purchasing agent, praying for a restraining order to enjoin the payment of claims under this contract. The Court, however, decided in favor of the purchasing agent on all important points. So far as we know, an appeal has not been taken. It is obvious that the effect of this decision is to make it unnecessary in the case of contracts for supplies for counties having an official purchasing agent, either to advertise for bids or to award the contract to the lowest bidder.

PEACE hath her expenses as well as war, according to the report of Mr. John S. Chambers, State Controller of California, regarding the total cost of government to the taxpayers of the State during the fiscal year ended June 30, 1916. The total cost was $175,868,482.94, of which the State government cost $36,035,889.77, the county governments $74,694,396.73, and the municipalities $65,183,196.44. There is probably some duplication in these figures, but, in any case, they are large enough to render the possibility of saving even a small proportion of the total amount worthy of serious consideration.

THE deficit in the general fund of Los Angeles county, which has been already discussed in these columns, has been investigated by the County Grand Jury. The report of that body charges three of the five members of the Board of Supervisors, together with the county treasurer and county auditor, with misconduct and asks for their removal from office. In a certain sense there is no question of dishonesty involved, since none of the officials appear to have profited by the acts with which they are charged. They have simply gone ahead spending more money that was available, until the climax came last January, when it was discovered there was a technical shortage of over $1,000,000 in the county funds. As a result, it has become necessary to suspend practically all new construction and reduce other county expenses to the minimum for the remainder of the fiscal year ending June 30. The only complete remedy for the present situation is the passage of a constitutional amendment enabling the county to levy a special tax to take care of the deficiency.

THIS unfortunate incident carries with it a lesson in these war-times when economy and care in the administration of both public and private funds is particularly important. As has already been pointed out in these columns, the officials of Los Angeles county are not any more careless or culpable than many other public officials throughout the country, only more unfortunate. In fact, there is some danger of a state of affairs of this kind in almost any community where the budget-system does not prevail. How long is it going to take some of our governmental bodies to learn the simplest principles of sound business?

ACQUISITION of the Denver & Rio Grande Railroad by the Western Pacific is likely to be the result of a recent decision in the United States District Court. It will be remembered that interest on the bonds of the Western Pacific was guaranteed by the Denver & Rio Grande, and that it was the latter road's defaulting on this interest that led to the foreclosure of the Western Pacific. The former bondholders of the Western Pacific, now its owners, have just obtained a judgment for $32,272,000 against the Denver & Rio Grande. After subtracting the Denver & Rio Grande funds impounded in the banks, there remains approximately $30,000,000 to be raised by that company. Since the company's stock has a market value of $15,000,000 and there is a funded debt of $124,000,000, foreclosure proceedings appear to be the logical outcome. The Denver & Rio Grande passes through a productive territory, but the property itself has been allowed to deteriorate for a number of years, money that should have been devoted to maintenance and betterments being diverted to other channels. It is estimated that it will cost $25,000,000 to place the road in first-class condition. The Western Pacific, on the other hand, is now earning a good rate of interest on its reduced capitalization. The railroads of the country are a particularly important factor in its welfare at this time, and if the Government shows a willingness to cooperate with them by granting reasonable rate-increases, and in other ways, it ought to be possible for the Western Pacific and Denver & Rio Grande, combined under one management, to attain a strong financial position.

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Methods of Reconstruction of California-Hawaiian Sugar Refinery Buildings at Crockett, California

By J. J. ROSENTHAL*

The California Hawaiian Sugar Refining Co. refinery is situated at Crockett, on the shore of Carquinez straits, about thirty miles from San Francisco by water. The water at Carquinez straits is deep and the channel crossing San Pablo bay is dredged to a depth of 35 ft., thus permitting ocean steamers to dock directly at the refinery. The plant is also on the main line of the Southern Pacific railroad.

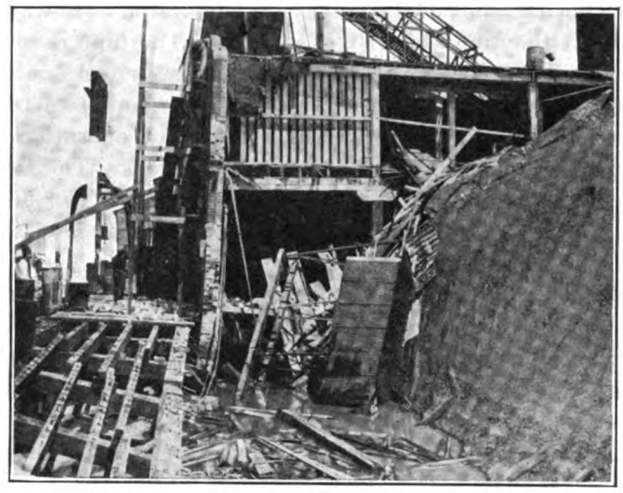
The plant originally consisted of two parts, a seven-story brick structure, and a series of one and two-story wooden warehouses, built on piles and running parallel with Carquinez straits. These buildings were constructed in 1881 by A. D. Starr & Co. and were intended to be used for a flour-mill. The interior of the brick buildings was of wood. This plant was operated for a short time as a flour-mill, and then remained closed for several years.

In 1897 a group of Hawaiian planters bought the property and converted it into a modern cane and beet sugar refining-plant, this being the first dual cane and beet-sugar refinery ever constructed in the United States. All the wooden columns, girders, and floors were removed and replaced with steel.

The buildings are constructed on a reef of rock that extends from the shore toward the straits. Solid rock is obtained at a depth of from 0 to 16 ft. Sheet-piling was driven, the mud removed and piers placed on the bedrock and brought to a point above high-water mark and about four feet below the floor-line. Groined arches rested on these concrete piers and supported the floor-slabs. The concrete was 9 in. thick at the thinnest part of the arch. Apparently in these days, 16 ft. was the approximate limit for this type of pier. Beyond the 16-ft. point contour-line piles were driven and wooden structures erected on the piles. The concrete foundations were designed to carry a floor-load of 1500 lb. per sq. ft., while the wooden structures were designed for 800 lb. per square foot.

After this plant was purchased by the Hawaiian planters, the California Beet Sugar & Refining Co. was formed. Machinery was installed and operations began in 1897. The refinery was operated with varying success until 1903, when the plant was closed. Difficulty was experienced in handling the beet-sugar end of the business, and it was found to be impracticable to operate both units at the same time.

In 1904 a reorganization took place, and in 1906 the California-Hawaiian Sugar Refining Co. resumed the refining of cane-sugar at Crockett. The beet-sugar machinery was removed and sold. Since then no beets have been handled at the plant. When operations were resumed in 1906, the melting capacity of the plant was about 280 tons of raw sugar per day. This capacity was gradually increased to 500 tons per day in 1910, 800 tons in 1914, and 900 tons in 1915. At present it is operating on a basis of 950 tons per day. Improvements now under way will increase the capacity to 1300 tons, beginning January 1, 1919. Buildings will be constructed and warehouse-facilities provided to handle ultimately 2000 tons per day, which will make this one of the largest plants in the world.



COLLAPSE OF PACKING-HOUSE, JULY 1911

During 1907 and 1908, it was found that many of the piles, while they appeared to be in good condition from the outside, had been attacked at the heads by dry-rot and that many of the caps under the buildings were in bad condition. After a systematic investigation it was found that extensive repairs were necessary.

The fire-menace was also a considerable factor in view of the large amount of sugar stored as well as the value of the buildings themselves. The danger of collapse was also imminent, as was demonstrated in 1911, when part of one of the warehouses collapsed into the bay, fortunately with no loss of life. The company decided at that time to reconstruct all its buildings of permanent fireproof material.

Since there is fresh water in Carquinez straits for three months in the year, the teredo does not destroy pile-foundations. At a point half-way between high and low-tide, piles that were driven thirty-five years ago are in as good condition now as the day they were driven. This permits the use of wooden piles.

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As several of the wooden buildings contain machinery which it is necessary to keep in operation, a rather unusual method of placing the foundations under these buildings had to be adopted. All foundations since 1911 have been placed so as to take the column-foundations of the buildings now about to be erected, the plans for the enlarged plant having been made at that time. A hole the size of the pier, usually about 8 ft. square, is cut in the first floor of the building. The superstructure is supported by false-work and the piling under the opening is removed. A redwood-stave pipe, 6 ft. inside diameter, made of 3 by 6-in. staves, is then dropped through the hole in the floor to the mud underneath the building. The pipe is held together by a number of bands of round iron made in two pieces, with an eye at each end. The bands are placed 4 ft. apart. A $\frac{3}{4}$-in. rod is run through the bands, and the bands are tightened so as to make the pipe water-tight. The bottom-ends of the staves are chamfered both ways, so that they may be driven straight. The pipe is then set on its true centre and the staves are driven one by one to bedrock. Each stave is driven about two feet until the round of the pipe is made. The operation is repeated until all the staves rest on bedrock. The tops of the staves then show the conformation of the bedrock. The staves form, together with the mud on the outside, a water-tight seal.

Various methods have been adopted for removing the mud, depending on its character. At times the mud is stirred up by a water-hose and siphoned out with inch pipes. In other cases, it is removed with orange-peel buckets. Sometimes it is excavated by hand and removed by the bucket-hoists. When bedrock is reached, it is cleaned thoroughly with water under pressure, the final water and mud being siphoned out. If the bedrock has a decided slope it is leveled to insure a good footing. These pipe-caissons have been driven to a depth of 35 ft. The concrete is poured through a pipe, the bottom of which is in contact with the poured concrete.

As the work of excavation proceed, inside-rings are placed at points below the mud-line, depending on the depth, and usually about four feet apart. These rings are made in sections of 3 by 4 by $\frac{1}{2}$-in. angle-iron, and are so arranged as to be easily separated and removed when the top of the concrete reaches the ring. These inside-rings are used to prevent collapse of the caissons under heavy pressure and also for the protection of the men who are working in the caissons.

Sometimes obstructions such as old brace-piles, pipes that have been thrown overboard in times long past, ballast-rocks that have been discharged from ships, etc., prevent the staves from being driven to bedrock. In such cases the remaining staves are driven to bedrock and the pier is excavated to the obstruction, which is removed by bringing it into the inside of the caisson. The staves are then driven past the point of obstruction to bedrock. Where the piers were placed on the outside building-line along the water-front, there was not sufficient mud to make a good seal against the water. In such cases, the mud has been handled by agitation with water under pressure and removed by siphons, and the concrete has been poured through tremies under twenty feet of water. In one or two cases it has been necessary to send divers into the caissons to remove large boulders and other obstructions that could not be removed otherwise.

The caissons are filled with concrete to a point 4 ft. below the finished level. On top of the 6-ft. pier thus formed, a small pier has been constructed to the floor-line. After the concrete has set for seven days, timbers are placed on the small piers and the entire superstructure carried upon them. At the same time the rod is drawn from the outside-bands of the caisson and they are pulled to the surface. The staves are then pulled from around the pier and are used over and over again, as the work proceeds.

An effort was made to drive sheet-piling in the form of a square to bedrock, but it was found impossible to drive the staves in a vertical direction and also impossible to keep it tight. Solid steel castings made of $\frac{1}{4}$-in. metal were then tried, but this was also found to be impracticable on account of the difficulty of driving the 6-ft. casting through rocks, old pipe, debris from former building operations, etc., particularly as operations had to be conducted under the building where the maximum head-room did not exceed 13 feet.

When a sufficient number of piers has been poured to justify pouring a part of the floor slab, usually an area of 60 by 75 ft., all of the old wooden floor-system, joists, caps, and piles, is removed, the building then being supported by the small piers. Arches are then placed on the large piers in both directions. The floor slab is then poured with a minimum thickness of concrete of 10 in. It is reinforced heavily with $\frac{3}{4}$-in. twisted rods. Depressions are left in the surface for future column-footings. Necessary openings, manholes, drain-lines, etc., are placed as the concrete is poured. A 1:2:3 mixture is used. Samples of the concrete shows strengths from 2800 to 3300 lb. at 28 days.

When foundations are placed either in places where the superstructure of the buildings can be removed, or in court-yards, or in open spaces where no buildings exist, wooden piling is used. No piling less than 16 in. diam, at the point of cut-off, is allowed. The piles are driven with a No. 1 Vulcan steam-hammer to a penetration of $\frac{1}{6}$ to $\frac{1}{8}$ in. The number of piles varies according to the loads. The pier-loads range from 225 to 625 tons for total live and dead loads, each pile being calculated to carry 25 tons. The floors are designed to carry 2000 lb. per square foot.

During 1915 and 1916, 15,000 yd. of concrete was poured. About the same amount will be poured in 1917. The structures erected will be modern 'class A' and fireproof throughout. The buildings are of steel, with either brick or concrete walls. Reinforced concrete is used only for curtain-walls. The two-story warehouse group of buildings will be of concrete, while the re-

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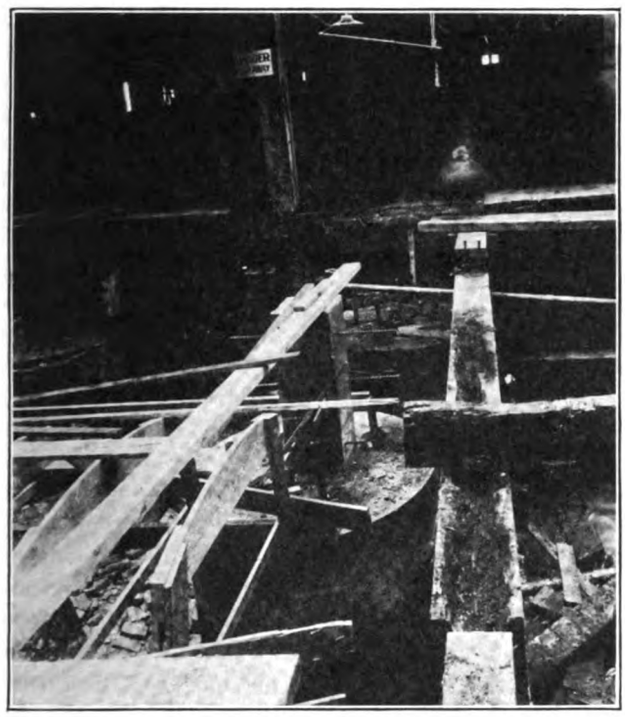
finery group will be of brick. The tallest building will be twelve stories high. This height is required in order to take the fullest advantage of gravity in handling the sugar in the refinery.

The plant at Crockett is equipped with many of the latest devices for fire-fighting such as the Gamewell fire-alarm system, which has also been extended by the company to take in the towns of Crockett and Valona. A sprinkler system has been installed throughout the plant. It is the wet system and was constructed by the Pacific Extinguisher Co., under the supervision of the Board of Fire Underwriters. The auto-call system is also a prominent feature. A monthly fire-drill is held at the plant; tests have shown that the first streams are playing on the supposed fire, irrespective



NEW CONCRETE-PIERS AND DECAYED TIMBERS OF OLD FOUNDATION

of where the alarm is turned in, within 18 seconds after the first alarm has designated the position of the fire. Within 25 seconds at least 16 streams of water, and as many more chemical streams, are in operation. It is the policy of the company to discharge all the chemical apparatus at every fire-drill, as it insures that the apparatus is in the best working-order. The insurance on goods stored in the new type of building is at a rate of 21c., while the rate in the old type is 65c. It is the intention of the company to replace all of the old wooden structures with new fireproof buildings. It is estimated that it will take four years to accomplish this result.

The company does most of its work by day labor, instead of by contract. The main reason for this policy is that it is difficult for the company to prepare specifications and plans that would serve as a guide to a contractor in bidding, since the work requires the removal of old structures and maintaining a large amount of machinery under constant operation, as well as providing for other unforeseen contingencies.

The company believes in safety first. Every provision is being made for the safety of its employees in the operation of the plant and also of its employees on construction work.

The safety committee in charge of this work is composed of five employees who have power to install safety-devices or make other changes. This committee fills its own vacancies, one member retiring every six months. Much good has resulted in preventing and minimizing accidents to the employees on construction work, as well as in the plant.

A large part of the credit for the prevention of accidents in this plant an on construction work is due to George M. Rolph, general manager for the company. Mr. Rolph is in direct charge of the construction work and under him are a consulting structural engineer, an architect, and two construction engineers. It is estimated that the work will cost when complete about $3,000,000.

The construction of a railroad tunnel 13 miles long through the Hindu Kush mountains between Turkestan and India is being considered. The Bokhara Railway system, which is owned by Russian capitalists, has its present terminus at Termez, near the boundary between Russian Turkestan and Afghanistan. From this point to Peshawar, on the Indian side of the Khyber pass is only 550 miles. The proposed railroad would follow the Oxus and Kundus rivers and then pass through the tunnel already mentioned to the headwaters of the Kabul river, a tributary of the Indus. Except for the tunnel mentioned, the construction difficulties would be comparatively small. The completion of such a line would provide a much quicker route between Europe and India than now exists by way of the Suez canal. The time between London and Delhi would be 6 days, as against 17 at the present time. This route would also be more satisfactory than any of the other proposed all-rail routes between Europe and India.

Slag for concrete aggregate was discussed by Sanford E. Thompson in a paper presented at the annual meeting of the American Concrete Institute. Tests have shown that concrete made from the slag obtainable in northern and eastern Ohio developed a strength at 28 days that was about 50% higher than first-class gravel concrete. About 15% more cement per cubic yard of concrete is required when using slag than when using gravel. No authentic cases of deterioration of well-made slag-concrete or of rusting of steel embedded in slag-concrete have been discovered. The process by which the slag is produced appears to make little or no difference in the strength of the concrete. The average weight of slag-concrete is 6% less than the average weight of gravel-concrete. Sufficient tests regarding permeability of slag-concrete have not yet been made to furnish definite information on this point.

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Effect Upon Output of Hours of Labor and Conditions of Employment in Factories

Bulletin No. 221 of the U. S. Bureau of Labor Statistics on 'Hours, Fatigue, and Health in British Munition Factories,' which has been recently issued, is of particular interest at the present time, since it is generally conceded that success in the War is largely dependent upon obtaining the maximum possible production in all lines of activity throughout the United States. In this case, as in many others, it is advisable that this country learn as much as possible from the experience of Great Britain during the past three years.

Some of the principal measures that were at first adopted in Great Britain to increase production were lengthening the regular hours of labor, overtime, and Sunday work. As the months passed, it became evident that this way of handling the question was not entirely satisfactory. The British Health of Munition Workers Committee was appointed in September 1915 by the Minister of Munitions "to consider and advise on questions of industrial fatigue, hours of labor, and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops." The committee has taken testimony in industrial centres and made personal visits to a number of workshops and factories. Up to April 1917, it has published 15 memoranda on various aspects of the question. The memoranda on Sunday Labor, Hours of Work, Output in Relation to Hours of Work, Industrial Fatigue and Its Causes, Sickness and Injury, Special Industrial Diseases, Ventilation and Lighting, and Effect of Industrial Conditions upon Eyesight, are given in the bulletin together with a copy of the Munitions of War Act and several other related documents.

Upon the subject of Sunday labor, the evidence before the committee led them to hold that "if the maximum output is to be secured and maintained for any length of time a weekly period of rest must be allowed. Except for short periods, continuous work is a profound mistake and does not pay in even the narrowest sence, since output is not increased. On economic and social grounds alike this weekly period of rest is best provided on Sunday.

"The committee desire to state that, in their opinion, the foremen and the higher management even more certainly require definite periods of rest. These individuals have never spared themselves, they carry a heavy burden of responsibility and they cannot be replaced. . . . It is of primary importance in the interests of the nation that they should be allowed that rest which is essential to the maintenance of their health.

"In conclusion, the committee desire to emphasize their conviction that some action must be taken in regard to continuous labor and excessive hours of work if it is desired to secure and maintain, over a long period, the maximum output. To secure any large measure of reform it may be necessary to impose certain restrictions on all controlled establishments, since competition and other causes frequently make it difficult for individual employers to act independently of one another."

In the preparation of the momorandum on hours of work in munition factories the committee seem to have been influenced by consideration of what is immediately practicable regarding the health of the worker in relation to a maximum output, in view of exceptional conditions entailed by the War. It is suggested that an increased number of hours may be obtained by overtime or by a system of shifts and that the committee greatly prefers the latter. The committee's objections to overtime, briefly stated, are: (1) It is liable to impose too severe a strain upon the workers, which affects adversely the rate of production and quality of output during the whole period of work as well as during the hours of overtime; (2) it frequently results in a large amount of lost time, which is attributed to workers becoming exhausted and taking a rest, and also to sickness; (3) it imposes a strain upon the management, the executive staff, and foremen, since they cannot take days of rest, like the ordinary worker; (4) it is likely to curtail unduly the period of rest and sleep available for those who have to travel long distances to and from their work, a matter of special importance in the case of young persons; (5) the fatigue entailed increases the temptation to indulge in the consumption of alcohol.

Admitting that overtime must continue, the committee suggested definite restrictions to govern it. For adult male workers the committee recommends:

1. The average weekly hours (exclusive of meals) should not exceed 65 to 67, including overtime. Hours in excess of 65 should only be worked for short periods and to meet sudden and unexpected circumstances. It may be desirable to differentiate to some extent between different kinds of work, and to fix a rather low limit of hours for work requiring close individual attention.

2. Where practicable, the overtime should be concentrated within three or four days in the week, which should preferably not be consecutive.

3. Where overtime is worked, it is especially important that there should be no Sunday work.

As respects women, the committee expresses the belief that the strain of long hours is serious and that conditions of work in excess of the normal legal limit

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of 60 hours a week ought to be discontinued as soon as practicable, although little objection is seen to such moderate overtime during the week as can be compensated by an earlier stop on Saturdays. Although it is recommended that boys should be allowed to be employed overtime up to the maximum suggested for men, it is thought that every effort should be made not to work boys under 16 more than 60 hours a week.

Although work on shifts involves night work, the committee makes it clear that night work is not to be regarded as a good thing in itself and offers the following objections to the system:

1. It is uneconomical. Though wages are paid at a higher rate, the rate of output, particularly during the last two or three hours of the 12-hour shift, is generally lower.
2. Supervision is frequently unsatisfactory.
3. Conditions of lighting are seldom as good as in daytime and this makes fine work more difficult.
4. Workers experience difficulty in sleeping by day.
5. The unfamiliar meal-hour makes it difficult for the workers to consume substantial food, and their digestion is liable to become deranged.

In its special study of output in relation to hours of work, the object of the committee was to ascertain the hours of employment most likely to produce a maximum output over periods of months or even years. It held that output cannot be maintained at the highest level for any considerable period if the conditions are such as to lead to excessive fatigue and to deterioration in the health of the workers. The committee's investigations covered operations of distinctly different character, some demanding heavy manual labor, others of a light, somewhat sedentary nature. It was found that the time-schedule producing the maximum output varied with the character of the operation.

The committee found that for men engaged in heavy labor, the maximum hours of actual work yielding the most effective results appear to be 56 or less per week, for men engaged in moderately heavy labor probably 60 per week, while for men and youths engaged in light labor, such as tending semi-automatic machines, probably 64 hours per week should be the maximum.

As a method of speeding up production, the committee recommended the careful regulation of rest-pauses. It was found that the operatives, if left to themselves, took rests at irregular and often unsuitable times, hence it would be much better if the rest-pauses were chosen for them. For instance, a 10-minute break in the middle of the morning and again in the afternoon during which the operatives remained at their machines, but took tea or other nutriment brought them by boys or by traveling canteens, has been found a valuable aid to output. Some types of work need longer and more frequent rest-pauses than others, and the best time can only be determined by experience. After being fixed, they should remain compulsory and rest-pauses at other times be checked as far as possible.

The committee's study of industrial fatigue and its causes is closely related to its three memoranda dealing with hours of labor. The committee had the benefit of studies of fatigue made by the Home Office and by a committee of the British Association for the Advancement of Science, and the committee's report may be regarded as a summary of these various studies of fatigue and of its own studies of hours of labor. The committee again emphasizes the importance of the regulation of hours and of daily and weekly rests, made with due consideration of the character of the work performed.

The conclusions of the committee are as follows: "The committee are bound to record their impression that the munition-workers in general have been allowed to reach a state of reduced efficiency and lowered health, which might have been avoided without reduction of output by attention to the details of daily and weekly rests. These signs of fatigue are even more noticeable in the case of managers and foremen, and the practical results are probably more serious than in the case of the workmen.

"It is important to note that a special and strenuous voluntary effort in labor, if it be maintained under a badly arranged time-table of work and rest, does not necessarily bring increased output over a long period, however praiseworthy the intention of effort may be. Under wrong conditions of work, together with excessive overtime, it is to be expected, indeed, that some deliberate 'slacking' of the workers might, by sparing wasteful fatigue, actually give an improvement of output over a period of some length, just as the 'nursing' of a boat crew over a part of a long course may improve their performance. It cannot under such circumstances be said that a workman so restraining himself, consciously or unconsciously, is doing more to damage the output, on the whole, than the employer who has arranged overlong hours of labor on the baseless assumption that long hours means high output."

In its report on sickness and injury, the committee pointed out certain injurious conditions which should be avoided as likely to diminish seriously the efficiency of the labor force. The injurious conditions enumerated are:

(1) Excessively long hours of work, particularly by night, if continued, produce fatigue, irritation, and sickness. "You will find," wrote Sir James Paget, "that fatigue has a larger share in the promotion of disease than any other single casual condition you can name."

(2) Cramped and constrained attitudes or posture during work, which prevent the healthy action of lungs and heart.

(3) Prolonged or excessive muscular strain, such as the lifting of heavy weights, prolonged standing, may produce rupture or varicose veins.

(4) Machinery accidents.

(5) Working in unventilated or insufficiently ventilated workshops predisposes to disease and interferes

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with individual energy and physical capacity to a marked degree.

(6) The air, even if fresh, may be too hot or too cold, too humid or too dry; either extreme should be avoided to insure reasonable bodily comfort and the most efficient work.

(7) Imperfect lighting, whether by day or night, conduces to eye-strain and headaches.

(8) Working with or in the presence of gases, vapors, poisons, and irritating substances may lead to direct poisoning.

(9) Dust produced in certain industries, unless effectually safeguarded, may induce lung diseases.

(10) The manufacture and use of high explosives involve risk to the workman.

Equally important with these influences, in the opinion of the committee, is the predisposition to disease arising from a failure to give proper attention to personal hygiene. In commenting upon these influences likely to impair industrial efficiency, the committee pointed out that "in the past, when the supply of labor was plentiful, the necessity for a study of the influences which affect human efficiency may have escaped recognition, but today, when skilled labor is scarce, the necessity is obvious. To conserve energy and efficiency is, other things being equal, the way to improve output."

For the purpose of remedy and treatment, the committee finds two elementary principles; namely, that prevention is better than cure, and that for treatment to be most effective it must deal with the beginnings of disease. The committee recommends, as a preliminary safeguard, the medical examination of all workers on their admission to the factory, in order to secure, as far as may be, their initial physical fitness for employment. In the opinion of the committee, the factory management has two further duties in the matter: first, they must reduce to a minimum any unfavorable conditions obtaining in the plant, providing proper sanitary conditions and accommodations, safeguarding machinery, controlling hours of labor, furnishing canteen facilities, and securing sufficiently warmed, lighted, and ventilated workrooms; second, they must make arrangements for an adequate medical and nursing scheme.

The committee points out the urgent necessity and value of first-aid work because of the increased number of accidents because of the abnormal demands of munitions-work. To meet these increased dangers, the committee suggests the adoption of various methods of prevention, such as guarding machinery, the adoption of safety appliances, regulating of dangerous processes, adequate lighting of the factory, and careful cleaning of machinery. The committee emphasizes also the need for the provision of suitable means of treatment, especially first-aid treatment, for minor injuries and the instruction of employees in first aid, and the thorough organization of first-aid and surgical provision. Systematic recording of all cases of sickness and accident the committee regards as of the utmost importance in the treatment of sickness and injuries.

The committee's report on special industrial diseases gives the causes, methods of prevention, and treatment for the principal industrial diseases which have been found to affect munition workers. These diseases are: Poisoning due to lead, trinitrotoluol, tetryl or tetranitromethylanilin, fulminate of mercury, tetrachlorethane, and nitrous fumes. Dermatitis, or eczema, caused by exposure to trinitrotoluol, tetryl, and fulminate of mercury, is also discussed.

The committee emphasizes the importance of facilities for the prompt treatment of all cases of sickness and injury, especially in those establishments where poisonous substances are used.

In its report on ventilation and lighting, the committee calls particular attention to the importance of adequate provisions for ventilation and lighting, in view of the special conditions under which work in munition factories is carried on at the present time. Efficient ventilation is essential for the maintenance of the health and comfort, and therefore the efficiency and capacity of the workers. The need of effective methods of ventilation is intensified at this time, not only by the increase in the number of workers, but also by the continuous occupation of shops by day and night. Under these conditions there is no interval in which natural ventilation can restore a vitiated atmosphere, and each shift succeeds to the bad conditions left by its predecessor.

The committee calls attention to the fact that bad lighting affects output unfavorably, not only by making good and rapid work more difficult but by causing headaches and other effects of eye-strain. The difficulties of supervision, which are always considerable, are further increased if the lighting facilities of the workshops are insufficient. The committee names as the essentials of good lighting: (1) adequacy; (2) a reasonable degree of constancy and uniformity of illumination over the necessary area of work; (3) the placing or shading of lamps so that light from them does not fall directly on the eye of the operator when engaged at his work or when looking horizontally across the workroom; (4) the placing of lights so as to avoid the casting of extraneous shadows on the work.

In its report on the effect of industrial conditions upon eyesight the committee calls attention to the need of special measures to prevent undue strain upon the eyesight or to reduce the liability to accidents to a minimum. These are: (1) testing of eyesight of operatives to be employed on close work and supplying them with glasses where necessary; and (2) guarding the eyes from flying particles of metal by the use of goggles.

General measures designed to improve the physical health of the workers and so to enable them to resist the effects of fatigue include the proper lighting of factories, the provision of canteens, and adequate time for rest and sleep.

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The Sevier Bridge Dam*

By CLARENCE S. JARVIS†

The Sevier Bridge dam, near Juab, Utah, was planned and promoted first by one company and then by another, for several years before the project took definite form in the way of construction. For years the settlers in the vicinity had built diverting-dams near the present site of the town of Delta, of brush, timber, and rocks, on a foundation of fine silt and clay, only to see the structures undermined and destroyed by high water. Then after waiting for the recurrence of the low-water stage to construct the diverting-dam, they were often disappointed because by the time the barrier was established and made fairly tight, the flow of the river was insufficient for their needs; and the half-matured crops on the parched clay soil of the desert withered and failed. Finally the settlers undertook the regulation of the Sevier river, filing in 1902, on the reservoir-site and water sufficient to supply 70,000 acres of land.

This filing was made in the middle of a cycle of years when there was the greatest deficiency in precipitation and runoff of which we have record, the Weather Bureau data extending back to 1874, and the gauge-readings on Great Salt Lake to 1850. During the five-year period from 1901 to 1905 inclusive, the estimated runoff at Sevier Bridge dam-site, from interpolation between the observed runoff at Leamington and Gunnison, was about 100,000 acre-feet, or about 35% of the average runoff from 1890 to 1893.

The lack of hydrographic data at the time of filing and of beginning construction was perhaps the greatest obstacle to the success of the undertaking, resulting in discouragements from adverse reports on the water supply, and in underestimating the required sluiceway and spillway capacities to control the river-flow and to protect the structure in its early stages. Year after year, during this early construction, while the river-flow was increasing and resuming its normal runoff, the builders were confronted with the problem of taking care of more water than they had expected, and the earth-fill was repeatedly in danger of overtopping. In the spring of 1907, all of the teams and men that could be impressed into service were working day and night by relays. In spite of this the reservoir-surface was gaining on the crest of the earth-fill at the rate of nearly a foot per day, with only two feet of freeboard remaining. In order to raise the crest safely a new berm would have had to be brought from the base along the downstream toe, nearly fifty feet vertically. At this time the flood receded.

In 1908 the old dam was completed to the 67-ft. level, with a 100-ft. width of spillway in solid rock at an elevation of 60 ft. During the succeeding years the interested companies were accustomed to plan to retain the water to the 60-ft. level. However, the appearance of wet spots at about Elevation 40 on the downstream slope, indicating a plane of saturation on a grade of about 1:6, together with the fact that the projects down the river did not require the extra storage at that time, always changed the plan. The reservoir would be drawn down to the 50-ft. level and then allowed partly to refill with the last of the surplus water.

In 1912, after much delay from litigation, plans for the enlargement of the dam were submitted to the State engineer, following in the main the recommendations of the late James D. Schuyler, who had been retained to study the problem in 1911. The construction of a concrete core-wall was begun. Because of the difficulty in making the deep excavation through saturated and unstable materials in the river-bed, only the south wing-wall and about half of the north one were completed from bedrock to the surface of the upstream fill.

JUNCTION OF SHEET-PILING AND DIAPHRAGM

In 1913 the sluicing-plant was installed, and preparations were made for the hydraulic fill downstream from the old dam. The upstream extension of the base was completed to an elevation of 20.5 ft. above the tunnel-grade, and the tunnel-floor and the rock fill for downstream toe were completed.

Early in the season of 1914, sluicing was begun for the downstream fill, but delays were occasioned by the collapse of the penstock-pipe supplying the turbine that operated the pumps. On one occasion, this was because the plant-operator opened the turbine-gates in excess of the opening at the main-gate at the pipe-intake, causing a partial vacuum and a flattening of the pipe for the first few feet. Another time, a fall of rock from the roof of the tunnel broke the steel penstock-pipe, allowing it to swing around in the swift current of the outflow through the tunnel.

By the time the plant was finally operating smoothly,

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†Salt Lake City, Utah.

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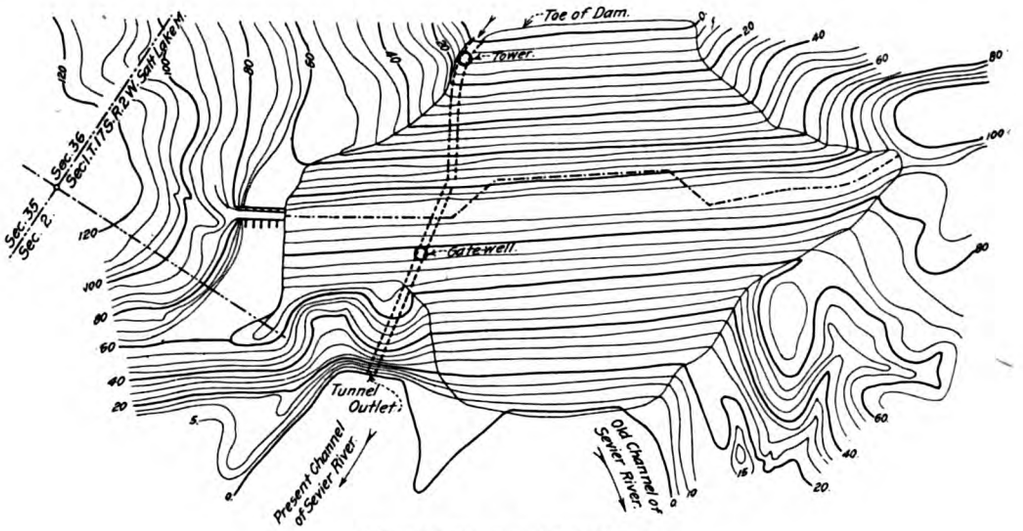
the reservoir-surface was at Elevation 59. The combined influence of the saturation of the lower part of the dam, together with the sluicing-pool along the downstream toe, caused a mass on the downstream slope, 40 ft. long,



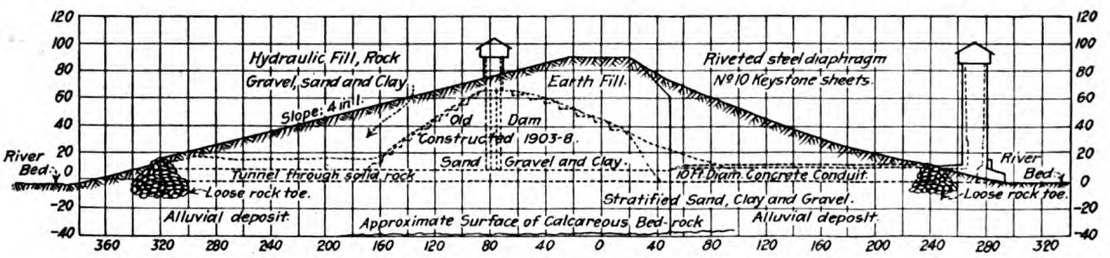
TOPOGRAPHIC MAP OF DAM-SITE

40 ft. wide, and 12 ft. thick to slide bodily down the steep slope and into the sluicing-pool. Three or four such slips would have released the 100,000 acre-feet of stored water. To prevent this, the sluice-gates were opened wide, thus lowering the reservoir-surface. A clay blanket was built on the water-side of the upstream slope, opposite the slip. Drain-tile and metal troughs were provided for the water seeping through the dam at the 40-ft. level, which amounted to six or eight gallons per minute. The discharge from the sluicing flumes was directed to the downstream toe of the dam below the slip. In 48 hours the immediate danger was past.

With the downstream fill at Elevation 50, the water was run through the spillway in March, 1915, and the structure was practically completed to the 90-ft. level in June, 1916.

It is probable that most of the established irrigation engineers of Utah, as well as several prominent engineers from other States, have taken part in the study of the problems here presented. Some of these problems were:

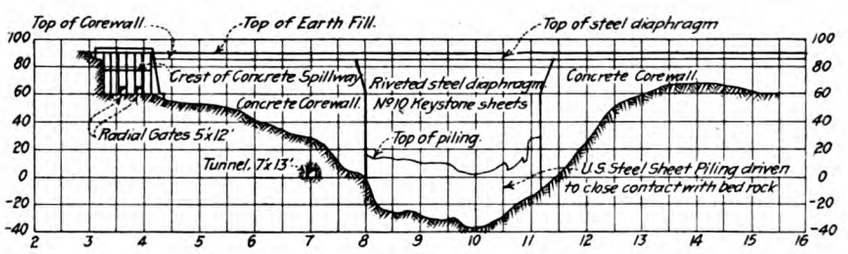
1. To cut off the seepage under the dam.



CROSS-SECTION OF DAM

2. To enlarge the cross-section and flatten the slopes.

3. To serve the requirements of the dependent irrigation companies, and still accommodate the deep foundation work.



PROFILE OF DAM

4. To harmonize the preferences of the various irrigation companies, the findings and recommendations of the various engineers and other representatives with voting powers; to take full advantage if possible of the construction done piecemeal, and under changing administrations, and with plans undergoing revisions; and yet to make creditable progress and obtain full value for the ex-

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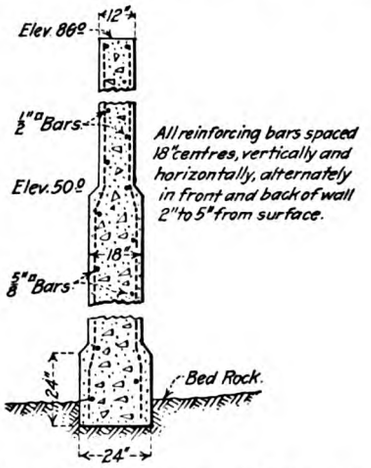
pense during the intermittent construction season between required storage-periods. It might appear that with such varied interests to serve, and such perplexing conditions to meet, the difficulties were much greater than would have been encountered if the old dam had not been upon the ground. However, it was the service rendered by the old dam during its many years of use that made it economically possible to carry the larger undertaking to a successful conclusion.

Among the unusual features of construction may be noted the extension of the tunnel as a reinforced concrete conduit; the two gate-towers with independent sets of gates for controlling the outflow; the reinforced concrete spillway, equipped with two radial gates, 5 by 12 ft., at the 60-ft. level, and an overflow crest 70 ft. in the clear, 13 ft. below the present crest of the dam.

In mid-channel there is a cut-off wall of sheet-steel



CROSS-SECTION OF REINFORCED CONCRETE CORE-WALL

piling, surmounted by a riveted-steel diaphragm, encased in asphaltic paint. Connected with this steel wall and diaphragm, and extending from bedrock to an elevation of 86 ft. along or near the axis of the dam, is a reinforced concrete core-wall.

The pile driving was attended with great risk and uncertainty. About 200 tons of 12½-in. United States sheet-steel piling, weighing 30 lb. per lin. ft., was driven in 20, 30, and 40-ft. lengths to a firm contact with bedrock. Inspection in the shafts at each end, where the connection was formed with the concrete, showed that the deepest sections of the wing-walls were set on firm bedrock, and that the piling actually penetrated several inches into the weathered surface of the rock strata, after passing through a layer of spalls and boulders. The actual driving required 30 days, with night and day shifts of from five to eight men. The total cost of installation, including plant and preliminary work, was 35c. per ft., or not quite 1c. per lb. of metal.

The cost of the entire cut-off wall, core-wall, and diaphragm was $62,000, or about 16% of the cost of the dam, and about 8% of the cost of the dam and reservoir-site.

Perhaps the one feature upon which engineers will differ most is the value of the diaphragm in such a structure. It should be noted, however, that those who have made the most thorough study of the conditions obtaining at this dam and the dependent projects were the strongest advocates of a core-wall and diaphragm for this particular structure. With the increase of the base of the dam from 300 to 680 ft., and the installation of the cut-off wall, core-wall, and diaphragm, has come a reduction of the flow over the weir near the downstream toe, with the reservoir-surface about 55 ft. above the tunnel-floor, from 0.73 second-foot to 0.06 second-foot. Most of the present flow comes from permanent springs.

The area of the reservoir-surface at the 60-ft. contour is about 3700 acres, and the capacity 104,000 acre-feet; while at the 80-ft. contour, the maximum storage level intended, the area is nearly 10,000 acres, and the storage capacity 250,000 acre-feet. The storage of this body of water at a cost of $3 per acre-foot has already been of untold benefit to the communities along the river, although only a part of the increased capacity was utilized during the past season.

CREOSOTED WOOD-BLOCK PAVEMENTS*

Wooden paving-blocks are manufactured in three sizes, 3, 3½, and 4 in. deep. They vary in length from 5 to 10 in., and in width from 3 to 4 in. There are a few patented blocks on the market, but the amount used is so small compared with the total output that they are relatively of minor importance. The depth of blocks to be used is dependent on traffic conditions. The width should be either greater or less than the depth, in order to assure blocks being laid with grain vertical. The length depends somewhat on the depth. For 3-in. blocks the length should not exceed 8 in.; 4-in. blocks may have a maximum length of 10 in. As a rule, 3-in. blocks should be used on residence streets, 3½-in. blocks on business streets of cities under 150,000 population, and 4-in. blocks on business streets of cities over 150,000, with 3½-in. blocks on semi-business streets.

All wood-block pavement should be laid on a concrete base. The thickness of this base depends on the character of the subsoil and the weight of the traffic. On an average, 5 in. of concrete is sufficient. The concrete should be put in sufficiently wet to assure a smooth surface laid to proper grade and crown. The smoother the surface, the smaller the amount of cushion material needed. The object of any cushion is to equalize the irregularities of the concrete and the under-surface of the pavement. As the creosoted blocks are manufactured with true plane surfaces, the concrete is the only thing to be considered. Several materials are used for the cushion: sand, grout, and a painting of bitumen. A thin cement-grout is now advocated as the standard. If the cushion is of sand, only enough to give a true laying-surface should be used. In making the grout, a mixture of one part cement to four parts of sand, moistened sufficiently to mix and spread freely, is best.

*Abstract of bulletin by Walter Buechler, published by National Lumber Manufacturers Association.

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TANK EARTHWORK

By H. N. HERRICK

The formulas on the opposite page are for use in calculating the quantities of earth-work involved in the preparation of sites for large steel tanks. By the use of these formulas, all calculations may be made directly in the field-book used in setting grade-stakes, without drafting-instruments or planimeter. This is of special advantage when several sites are to be compared in the field to determine which will require the least grading.

Special formulas are given for grades 125 feet in diameter, usually used for 55,000-bbl. oil-tanks of 114 ft. 6 in. diameter, and for grades 105 ft. diam. adapted to the 37,500-bbl. tanks in common use in the oil business. A general formula is given for smaller grades. While the calculation appears rather complicated at first glance, its simplicity will be apparent on comparing the example worked out for a 125-ft. grade with a similar computation by some of the other common methods.

The derivation of these formulas is too tedious to be given in detail, but it may be outlined as follows:

(1) The cylindrical figure whose horizontal projection is the base of the grade is made up of a number of prisms, the areas of whose horizontal bases are known from the conditions assumed, and whose vertical edges are the 'cuts.' The volumes of these prisms are calculated, the cuts being represented by the letters shown on the diagram, added together, and reduced to cubic yards.

(2) The ring, of varying triangular section, outside of the cylinder, is treated as follows: The area of the triangular section at each 30° line is expressed in terms of the cut at the edge of the base and the elevation of the slope-stake (set where the excavation meets the natural surface), the slope of the bank being given. The distance from the centre of the grade to the centre of gravity of this triangular area is found in terms of the same quantities and the radius of the grade, and the volume generated by swinging the triangle through 30° calculated according to Guldin's principle. The volumes thus found are added together, reduced to cubic yards, and added to the volume found in (1).

The formulas apply equally well to a grade that is to be made entirely in fill, by substituting "fill" for "cut" throughout. Tank-grades should never be built in both cut and fill, for obvious reasons.

METHODS AND COSTS OF STREET IMPROVEMENT IN BAKERSFIELD, CALIFORNIA

A report recently issued by Wallace M. Morgan, for the past two years city manager of Bakersfield, California, contains methods and summary of costs of street work in that city, particularly grading and oiling the less-traveled streets. The soil is either sand or loam. Gravel or rock have to be hauled several miles. Road-oil and other asphaltic products are obtained from refineries near the city, or from the Midway-Sunset oil-fields, 40 miles distant. The average rainfall is seven inches per year, mainly in the winter months. The climate in summer is hot.

Sheet-asphalt pavement on concrete base has cost from $0.1224 to $0.157 per sq. ft., including grading, on recent contracts. Oil-macadam pavement has cost from $0.06 to $0.0957 per sq. ft., including grading. Grading and oiling has cost from $0.035 to $0.055 per sq. ft., and grading alone from $0.01 to $0.015 per sq. ft. This work was all done by contract, either private or under Street Improvement Act. It is probable that the contractors on the grading and oiling jobs in particular, were compelled to bid unusually high to allow for the trouble and expense of handling work under the Act, when the amounts to be collected from each property-owner are small.

Recently the city has adopted a policy of furnishing the oil if the property-owners will pay for the grading, the work being done by the street department. Mr. Morgan recommends that, in future, the grading and oiling of streets be paid for from the city funds, leaving the property-owners to pay directly only for permanent work, such as sidewalks, curbs, gutters, storm-drains, and pavements.

The grading and oiling done by the city has not been so complete as would be required of contractors, but it is believed that it is as satisfactory for all practical purposes. In cases where it would have been necessary to haul material to bring the streets to the exact grade, they have been left in places from one to three inches below grade, but the road-bed has been made smooth and firm, and good drainage has been provided. Enough oil is applied to hold the material firmly during the first season. After travel and the rains of the first winter have completed the packing and settling of the road-bed, it is worked with a street-planer to smooth the surface and to mix the oil already applied more thoroughly with the earth. When this has been done, a light coat of oil and a top-dressing of sand or screening is applied.

The cost of this work for the first season for both grading and oiling is from ½ to 1c. per sq. ft. and for the second season about the same. After this the cost of maintenance under light traffic is small. In fact, a street that has been oiled and graded, even if it has fallen into bad repair, can be made smooth and uniform at a cost of from $\frac{1}{10}$ to ¼c. per sq. ft. For this work, a specially designed street-planer, drawn by six horses, is used. The street-planer is also used for planing waves and wrinkles from oil-macadam pavements that have been constructed with too much oil.

Mr. Morgan states that he believes that there is no intermediate street-improvement that is worth while, between grading and oiling, and permanent pavements. Where the traffic is too great for a carefully constructed and maintained oiled street it is time to lay a permanent pavement.

Cotton used for making explosives in the United States amounted to 83,652,907 lb. during the three months ended March 1917.

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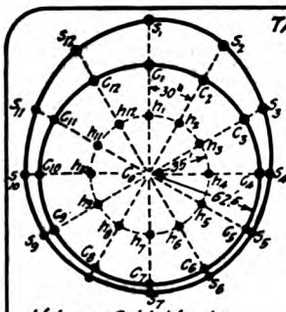


TANK GRADE 125' DIAMETER FOR 55 000-BBL. TANK

Find in field:
Cut at center, = C_0 (ft.)
Cuts at circumference, 30° apart, = $C_1 \cdot C_2 \cdots C_{12}$ (ft.)
Cuts at 35 ft. radius, 30° apart, = $h_1 \cdot h_2 \cdots h_{12}$ (ft.)
Elevations of slope stakes, $s_1 \cdot s_2 \cdots s_{12}$ (ft.) above grade.

Side slope $1\frac{1}{2}:1$

Volume, Cubic Yards:

$$V = 47.4\,C_0 + 20.92\,[h_1+h_2+h_3+\cdots h_{12}] + 13\,[C_1+C_2+C_3+\cdots C_{12}]$$
$$+ 0.909\,[C_1s_1+C_2s_2+C_3s_3+\cdots C_{12}s_{12}]$$
$$+ .007272\,[C_1s_1^2+C_2s_2^2+C_3s_3^2+\cdots C_{12}s_{12}^2]$$

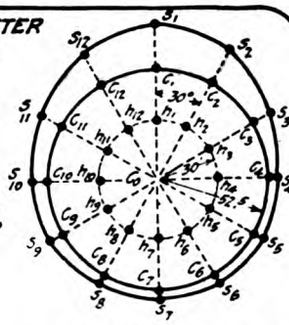
Or, Vol. of excavation in Cu. Yds. equals – 47.4 times center cut + 20.92 times sum of cuts on 35 ft. radius + 13 times sum of cuts at 62.5 ft. radius + .909 times sum of products of each cut at 62.5 ft. by its corresponding slope stake elev. + .007272 times the sum of the products of each cut at 62.5 ft. by the square of its corresponding slope stake elev.

The calculation may be most simply made in tabular form, by adding two columns, for Cs and Cs^2, to the ordinary field notes, adding up cols. and multiplying sums by factors given. Take cuts to nearest tenth of a foot.

If cuts at 35' radius are not taken, formula becomes:

$$V, Cu.Yd = 25.25\,[6\,C_0 + C_1+C_2+C_3+C_4+\cdots C_{12}]$$
$$+ .909\,[C_1s_1+C_2s_2+C_3s_3+\cdots C_{12}s_{12}]$$
$$+ .007272\,[C_1s_1^2+C_2s_2^2+C_3s_3^2+\cdots C_{12}s_{12}^2]$$

The above to be used only for sections 30° apart, slope $1\frac{1}{2}:1$, and radii as above.



TANK GRADE 105' DIAMETER FOR 37 500-BBL. TANK

Find in field:
Cut at center = C_0
Cuts at circumference, 30° apart, = $C_1 \cdot C_2 \cdots C_{12}$ (ft.)
Cuts at 30 ft. radius, 30° apart, = $h_1 \cdot h_2 \cdots h_{12}$ (ft.)
Elevations of slope stakes, $s_1 \cdot s_2 \cdots s_{12}$ (ft.) above grade

Side slope $1\frac{1}{2}:1$

Volume, Cubic Yards:

$$V = 34.9\,C_0 + 14.81\,[h_1+h_2+h_3+\cdots h_{12}] + 9\,[C_1+C_2+C_3+\cdots C_{12}]$$
$$+ 0.7636\,[C_1s_1+C_2s_2+C_3s_3+\cdots C_{12}s_{12}]$$
$$+ .007272\,[C_1s_1^2+C_2s_2^2+C_3s_3^2+\cdots C_{12}s_{12}^2]$$

GENERAL FORMULA, SMALL TANK-GRADES

Radius of Grade = R ft.
Cuts at circumference 30° apart = $C_1 \cdot C_2 \cdots C_{12}$ ft.
Center cut = C_0 ft.
Slope stake elevations = $s_1, s_2, \cdots s_{12}$ ft. above grade

Volume, Cubic Yards:

$$V = .006464\,R^2\,[6\,C_0 + C_1+C_2+C_3+\cdots C_{12}]$$
$$+ .014544\,R\,[C_1s_1+C_2s_2+\cdots C_{12}s_{12}]$$
$$+ .007272\,[C_1s_1^2+C_2s_2^2+\cdots C_{12}s_{12}^2]$$

The above apply only for sections 30° apart and other conditions as stated.

TANK GRADE NO. 765

Diameter 125'-for 55 000-Barrel Tank.

Rod reading at "Grade" = 11.5

Azimuth	35' Rod	Radius Cut h	62.5' Rod	Radius Cut C			Slope Stakes Radius	Rod	Elev. s	Cs	Cs^2
0°	6.0	5.5	7.9	3.6			67.5	8.2	3.3	11.9	39.3
30°	5.7	5.8	7.9	3.6			67.3	8.3	3.2	11.5	36.8
60°	5.4	6.1	7.4	4.1			69.1	7.1	4.4	18.0	79.4
90°	4.6	6.9	6.2	5.3			70.0	6.5	5.0	26.5	132.5
120°	3.9	7.6	3.9	7.6			73.9	3.9	7.6	57.8	439.0
150°	3.5	8.0	2.0	9.5			77.1	1.7	9.8	93.1	912.4
180°	3.0	7.7	2.6	8.9			77.1	1.8	9.7	86.3	837.4
210°	4.9	6.6	5.1	6.4			72	5.2	6.3	40.3	253.9
240°	6.4	5.1	8.4	3.1			66.7	8.7	2.8	8.7	24.4
270°	7.2	4.3	10.2	1.3			62.5	—	—		
300°	6.9	4.6	9.3	2.2			62.5	—	—		
330°	6.3	5.2	8.1	3.4			65.6	9.4	2.1	7.1	14.9
Sums		73.4		59.0						361.2	2770.0
Factors		20.92		13.		Total Vol.:				.909	.007272
		1.5		177		$47.4\,C_0$ =	289.1			3.3	.01
		66.1		590		$20.92\,\Sigma h$ =	1535.6			325.1	.19
		1468.		767.0		$13\,\Sigma C$ =	767.0			328.4	.55
		1535.6				$.909\,\Sigma Cs$ =	328.4				19.39
Center	Cut =	6.1 = C_0				$.007272\,\Sigma Cs^2$ =	20.1				20.14
	47.4					Total Excavation	2940.7	Cu. Yds.			
	6.1										
	4.7										
	284.4										
	289.1										

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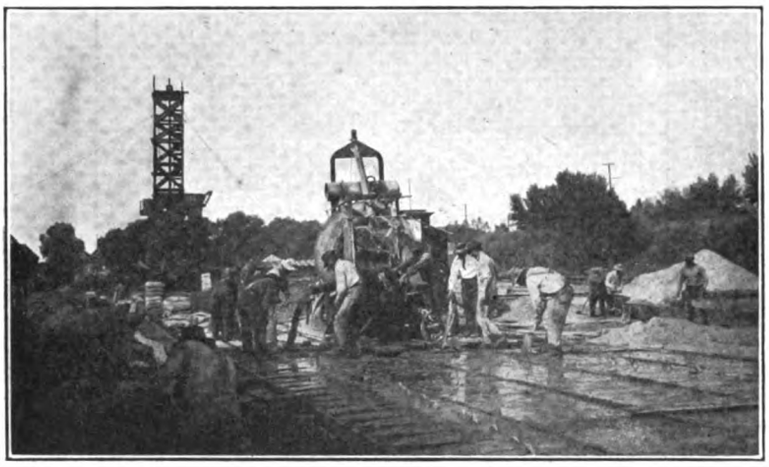
Methods of Construction of the Sacramento By-Pass Weir

By J. J. ROSENTHAL*

The maximum flow of the Sacramento river is 120,000 second-feet, and of the American river, 160,000 second-feet. The capacity of the channel of the Sacramento river opposite the city of Sacramento is 110,000 second-feet.

To take care of the excess water, over and above the capacity of the river at Sacramento, a by-pass weir is being constructed, which will allow the water to flow over the weir-rim at elevation 31 to the Suisun bay through the Yolo by-pass, which is an artificial channel and American River bottoms have also been flooded. These bottom-lands have acted as storage and equalizing reservoirs during the high-water periods. This land has now been almost entirely reclaimed and is no longer available as a storage-reservoir and by-pass. These conditions led to the construction of the Yolo by-pass and by-pass weir.

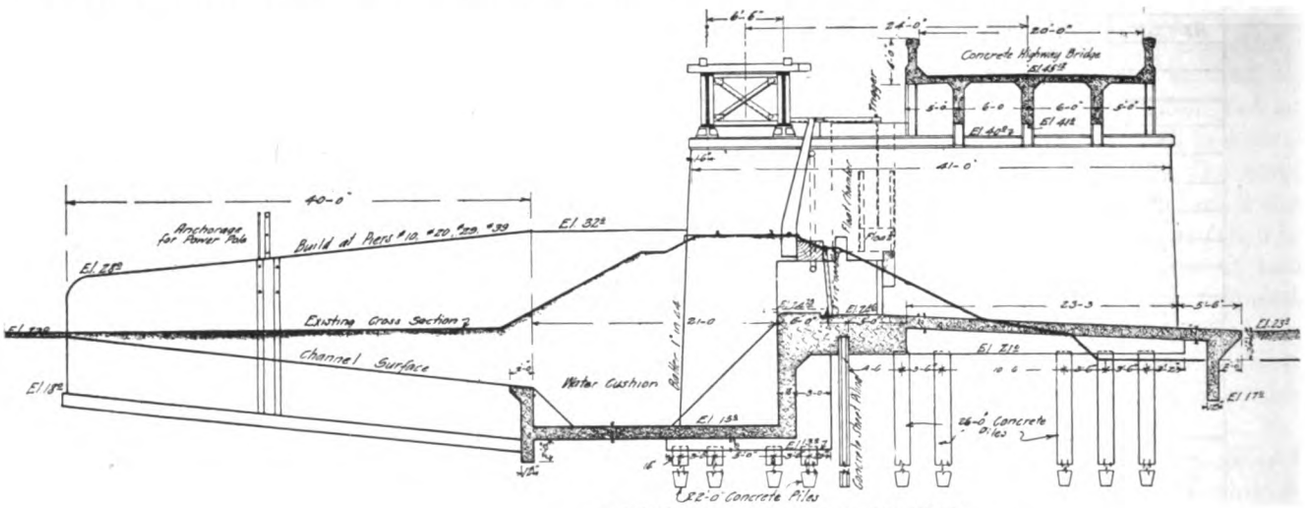


MAKING CONCRETE PILES

An elevation of the weir is shown below. One hundred thousand yards of loam earth was excavated with a 20-ton Ohio crane and drag-line excavator. The cost of excavating and removing the earth, including making a fill and raising one mile of railroad track, was $0.32 per cubic yard.

The foundation of the weir consists of 1450 reinforced concrete sheet-piles 18 to 26 ft. long, and 880 reinforced concrete square piles 22 to 26 ft. long, all of which were manufactured at the site. The sheet-piles were made with grooves at the sides so that they could be matched to each other. After the sheet-piles were driven, they were cleaned with steam-jets and filled with a 1:2 mixture of cement grout. There are 48 reinforced concrete piers in this structure each 3 by 41 by 20 ft. high.

The concrete is poured from a tower and mixing-plant mounted on a flat car. There are bins behind the mixer which hold approximately ten yards of material. These are filled by a 20-ton Ohio crane, part of the material being loaded directly from cars to the bins, the remainder from storage-piles along the work-track. A batch of cement, sand, and rock is measured in a hopper, delivered



SECTIONAL ELEVATION OF WEIR

ELEVATION OF WEIR

fixed by the California Reclamation Board. Heretofore, when the maximum flow has occurred in the Sacramento and American rivers at the same time, the Sutter, Yolo,

*Safety engineer, Industrial Accident Commission, Underwood Bdg., San Francisco.

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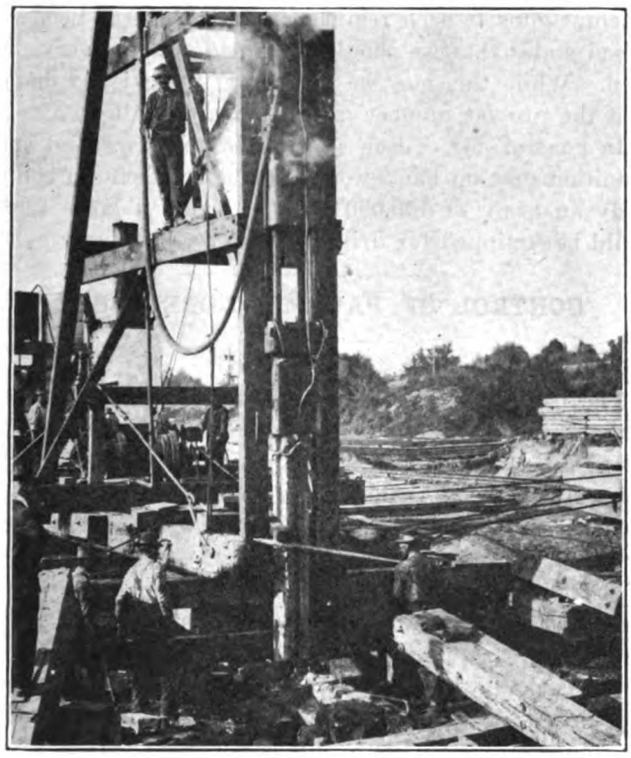
to the mixer, hoisted into the tower and carried to place in a chute. The maximum run per eight-hour shift is approximately 240 cu. yd. of concrete in place, and the average run is 190 cu. yd., allowing for time lost in moving the concrete-plant. Moving the concrete-plant is accomplished by moving two of the guy-lines ahead and taking up slack with a block-and-tackle, releasing the strain on the rear guy-lines at the same time thus keeping all four lines taut while the car is being moved. The car is moved by taking a pull on the 'niggerhead' of the hoisting-engine. The entire operation of moving takes about twenty minutes.

There is a needle-and-trigger device for controlling the



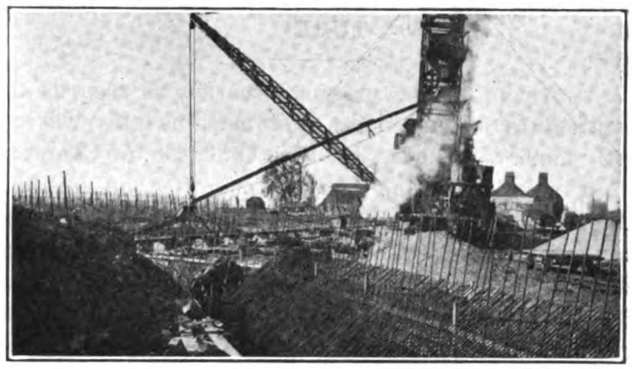
DRIVING CONCRETE SHEET PILING

water, consisting of 48 timbers, 20 by 28 in. by 38 ft., each supporting one end of a vertical flash-board. This device is released by a trigger controlled by a float, which is adjusted to let the water through at a predetermined height. The other end of the flash-boards is hinged to an 8 by 8 by 1-in. angle-iron in the floor of the weir. The total length of the by-pass weir from abutment to abutment is 2000 ft., and the width over all is 62 feet.

The North-Eastern Railroad was carried around the structure on a 'shoo-fly' track a little over a mile long, while about a mile of track was laid for switching. A railroad-bridge of 48 spans requiring 600 tons of steel in all will be constructed over the weir, and there will also be a highway-bridge of reinforced concrete beams with concrete floor-slabs covered with asphalt.

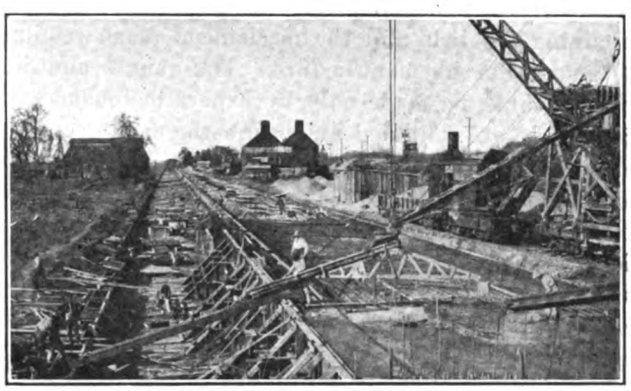
Teichert & Ambrose, of Sacramento, are doing the work under the direction of Frank C. Miller, city engineer of Sacramento. Will C. Horton is resident engineer in charge of construction. This work is a part of the general flood-control scheme for the Sacramento river, under plans approved by the Federal Government, the State of California, and the property-owners benefited, who, in this case, are represented by the city of Sacramento.

As construction engineer for the Safety Department of the Industrial Accident Commission of California, I have made frequent inspections of this work, and organized a Safety Committee consisting of T. E. Ambrose, a



REINFORCING STEEL IN WEIR-LIP WALL

member of the contracting firm, the superintendent of construction, and three of the foremen. This committee meets bi-monthly for the purpose of discussing safety-methods to be used on the work. They have absolute power to install any safety-device or make other changes



POURING CONCRETE FOR FOUNDATION OF SOUTH ABUTMENT

for the benefit of the workmen. This is the first safety committee to be organized on a construction job in California.

The total cost of the structure will be $350,000. Following is the cost of the safety-measures adopted: guarding 2700 ft. of third rail on the North-Eastern Railroad, $135; guarding rip-saw, crane, hoist, and mixing-plant, $145; shoring 2000 lin. ft. of trench, 10 ft. deep by 20 ft. wide, $285; total, $565.

The total cost of safeguarding 125 workers who were engaged in building this structure for a period of twelve months was therefore $4.52 for each worker. If a fatal accident had occurred it would have cost the contractors $2700 for compensation in the case of a laborer; or if a mechanic had been killed, it would have cost $5000. These sums represent only the economic loss. They

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would not pay for any life, nor relieve the mental sufferings of those dependent upon the workers. Past statistics show two to three fatal accidents for most jobs of this character and size. On this weir, however, there has been neither a fatal accident nor a permanent injury, and only twelve minor accidents, such as stepping on nails, scratching hands, or cutting fingers.

THE GAUGE-PROBLEM IN RIFLE-MANUFACTURE*

A statement of the present situation as regards the manufacture of both rifles and machine-guns was recently made to Congress by John Q. Tilson, of Connecticut, a member of the House Committee on Military Affairs. Mr. Tillson said that the Government had on hand at the present time approximately 800,000 Springfield service-rifles, and that the two arsenals at Springfield, Massachusetts, and Rock Island, Illinois, by working three shifts to their fullest capacity could probably manufacture 500,000 rifles per year. There are also about 350,000 Krag-Jorgensen rifles in existence, but their use is not recommended for various reasons, among them being the difference in ammunition.

To increase the output of this type of rifle by manufacture is impossible because of the lack of gauges, jigs, and other necessary tools and fixtures. A large number of these are required for making the service-rifle, which is composed of about 150 different parts. The receiver containing the bolt and the mechanism alone requires 120 gauges for its manufacture. The gauges and jigs can, of course, be made only by expert tool-makers, of whom there are a limited number in the entire country. It is estimated, if all the qualified tool-makers available should be taken off other work, and set to making gauges for the service-rifle, that it would take a year to make enough gauges to permit large-scale production of this one weapon. In the meantime, machine-guns and other field artillery and shrapnel would have to be entirely neglected.

On the other hand, there are now in this country, in the hands of private manufacturers, gauges and other equipment for making 15,000 per day of the Enfield rifle, which is the standard British weapon. The question of rapid production of arms then resolves itself into whether we manufacture Enfield rifles chambered for the regular ammunition used by the British army with that weapon, or whether we shall chamber these Enfield rifles for the Springfield ammunition, so that both kinds can be used.

The arsenals are also manufacturing a large number of the new service-pistol, but are not making them fast enough to equip the new officers that will be taken into the service. Both rifles and pistols have felt the high cost of living. The cost of manufacture of the Springfield rifle used to be $15 and is now $25.

Shrapnel manufacture also requires a large number of gauges. About 300 are needed for the 3-in. shell, containing 252 bullets encased in resin. It is equipped with a fuse that can be set for any time up to 21 seconds, and there is a black-powder charge at the base. The object of the gunner is to make his shrapnel explode a short distance in front of the target. The bullets then leave the shell in a fan-shaped stream, and the burning resin and powder show the gunner where the shell is exploding.

Several types of machine-guns are in service, including the Hotchkiss, Colt, Marlin, Vickers, and Lewis. The Navy has ordered 1600 Marlin guns for shooting submarine periscopes. About 300 Lewis guns were purchased last summer, and deliveries are now being made of Vickers guns. At present, the Army has only four machine-guns to each regiment, which General Leonard Wood states that we should have one gun to every ten men. While this may be too many, there is no doubt that the present number is ridiculously small.

In general, Mr. Tilson stated that the arms and ammunition now on hand would not be sufficient to equip fully an army of 100,000 men, although a large force could be equipped for drilling alone.

*Abstract from *The Iron Age*.

CONTROL OF PAVEMENT-OPENINGS*

By E. P. GOODRICH†

The best way to treat a pavement-opening is not to make it. In order to accomplish this end:

(a) Place sub-surface structures under sidewalks and grass-strips. This is the German method, and has been demonstrated more efficient economically than the construction of pipe-galleries.

(b) Whenever a pavement is to be replaced over a large area, sub-surface structures should be renewed, or at least carefully examined and repaired; house-connections should be treated similarly, and the ground restored to as nearly virgin condition as possible under the new pavement. To secure this result, corporations owning sub-surface structures should be notified in time to permit them to do this work. Householders should be notified to examine their structures, signs should be posted upon the street stating that the street is to be repaved, and sub-surface structures must be carefully examined and prepared. Efforts should be made to force the corporations and property-owners to make needed repairs to their structures while the pavement is open. This may mean a revision of the franchise law, and it may mean a change of ordinance.

Except in cases of emergency, permits to open a newly-laid pavement should be refused. The period of such refusal might extend to several years. Hartford, Connecticut, is said to allow no openings in new pavements except by action of the city council during a period of 10 years. Taking for granted that some cuts must be made, it is obviously essential to know where the sub-surface structures are actually situated.

*Abstract from a paper read before the Citizens' Street Traffic Committee of Greater New York.

†Consulting engineer, New York.

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Central-Power and Jack-Pumping Plants for Operation of Oil Wells—Part II

By ROY M. BARNES*

A counter-balance is used to help balance the well-loads about the central-power plant. It can also be used as a multiplier to increase or decrease the length of the stroke. The load in the weight-box can be varied to suit the conditions. This is particularly necessary on a property where new wells are being added to the load on the plant, requiring a re-balancing of the system. The line is connected to the counter-balance by the following hardware, in the order named: pipe-eye, C-link, turnbuckle, C-link, pipe-eye, and stirrup. The bill of material is as follows:

LUMBER		
One 8 by 8 in. by 16 ft., cedar	$3.44	
Seven 2 by 12 in. by 12 ft., Oregon pine		
Two 6 by 8 in. by 10 ft., Oregon pine		
One 6 by 8 in. by 5 ft., Oregon pine		
One 6 by 8 in. by 8 ft., Oregon pine		
One 6 by 6 in. by 2 ft., Oregon pine		
Two 2 by 6 in. by 14 ft., Oregon pine	11.69	
		$15.13
HARDWARE		
Two sets swing-post castings, complete	$24.00	
Two 1½-in. stirrups	4.70	
Two stirrup-plates	0.60	
One turnbuckle	4.25	
Two C-links, with link	2.30	
Two 1½-in. pipe-eye connection	2.50	
Twelve ¾ by 8-in. machine-bolts	0.50	
Six ¾ by 15-in. machine-bolts	0.84	
Four ¾ by 10-in. hook-bolts	0.60	
Four 1-in. cast washers	0.22	
Forty-four ¾-in. cut washers	0.22	
		43.23
Total material		$58.36
Total labor		17.50
Total		$75.86

Jack-pumps are used to pump the oil from gathering-stations to the central shipping-tanks. They are also used sometimes at the well as tail-pumps to transfer the oil from the well to the gathering-station. The weight-box is required in order to produce the downward stroke. The type of pump shown works upon the principle of the Oklahoma jack. A turnbuckle connection, similar to that used with the counterbalance-weight, is desirable to take the slack out of the line. The capacity of the pump should be considerably more than the normal production of the wells served by the gathering-station. A bill of materials for the pump is as follows:

LUMBER		
One 8 by 8 in. by 16 ft., cedar	$3.44	
One 6 by 8 in. by 10 ft., Oregon pine		
One 6 by 8 in. by 8 ft., Oregon pine		
One 6 by 8 in. by 12 ft., Oregon pine		
Two 2 by 12 in. by 12 ft., Oregon pine		
One 2 by 12 in. by 16 ft., Oregon pine		
One 2 by 12 in. by 8 ft., Oregon pine		
Two 2 by 6 in. by 16 ft., Oregon pine		
One 2 by 6 in. by 8 ft., Oregon pine	8.96	
One 2 by 6 in. by 5 ft., hardwood		
One 2 by 10 in. by 5 ft., hardwood	1.80	
		$14.20
HARDWARE		
One set swing-cost castings, complete	$12.00	
One 1 in. by 7 ft. 3-in. double-end bolt	1.20	
One 1½-in. stirrup	2.35	
One stirrup-plate	0.30	
One turnbuckle	4.25	
Two C-links with link	2.30	
Two 1½-in. pipe-eye connections	2.50	
Two ¾ by 10-in. hook-bolts	0.60	
Three ¾ by 13-in. machine-bolts	0.36	
Eight ¾ by 8-in. machine-bolts	0.36	
Four ¾ by 10-in. machine-bolts	0.40	
One 1½ by 18-in. nipple	Nominal	
Four ½ by 2 by 18-in. straps	1.80	
One 4-in. plunger-pump, complete with working-barrel, stuffing-box, etc. (Not charged against jack-pump)	....	
		28.42
Total material		$42.62
Total labor		20.00
Total cost		$62.62

The weight of lumber is 880 lb., and of hardware, not counting the pump, 300 lb., or 1180 lb. in all.

Structures at the Well. The pumping-jack is the device at the well that transfers the horizontal reciprocating motion given by the central power to the transmission-lines, to the vertical reciprocating motion required by the sucker-rods to actuate the plunger-pump. There are two principal types of steel jacks, the Oklahoma jack shown in Fig. 11, and the Jones & Hammond or J & H jack, shown in Fig. 12. Wooden jacks are used sometimes.

The Oklahoma jack is a combination triangle and walking-beam. The jack itself is made of structural steel, and should be mounted on a rigid supporting structure of Oregon pine. The lower fulcrum is furnished with the jack, and is bolted to a 12 by 12-in. timber. The length of stroke can be regulated at the well by changing the different fulcrums. This facilitates experimenting on the length of stroke required

*Care General Petroleum Corporation, Taft, California.

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for best results at the well, and also reduces the number of multipliers needed on the line.

It is evident that there are an infinite number of

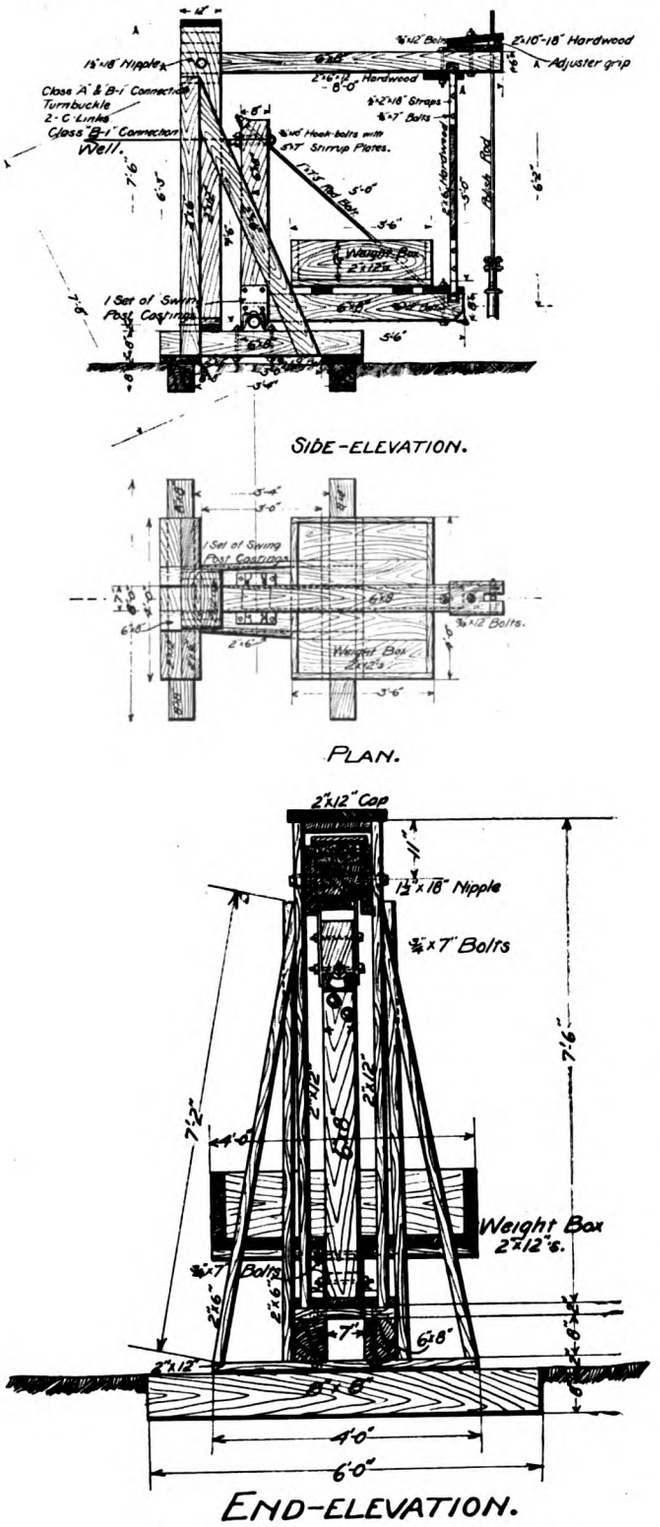

FIG. 10. PLAN AND ELEVATION OF JACK-PUMP

combinations for different lengths of stroke, depending upon the choice of fulcrums and on the arrangement of the supporting structure itself. The jack will work the easiest for long lever-arms on the walking beam, and short distances between the pitman and the polished-rod. Where

X = ratio between length of stroke at polish-rod to length of stroke at shackle-line.

A = triangle-arm, vertical leg.

B = triangle-arm, horizontal leg.

C = pitman-arm.

D = pumping-arm, then $X = \frac{BD}{AC}$

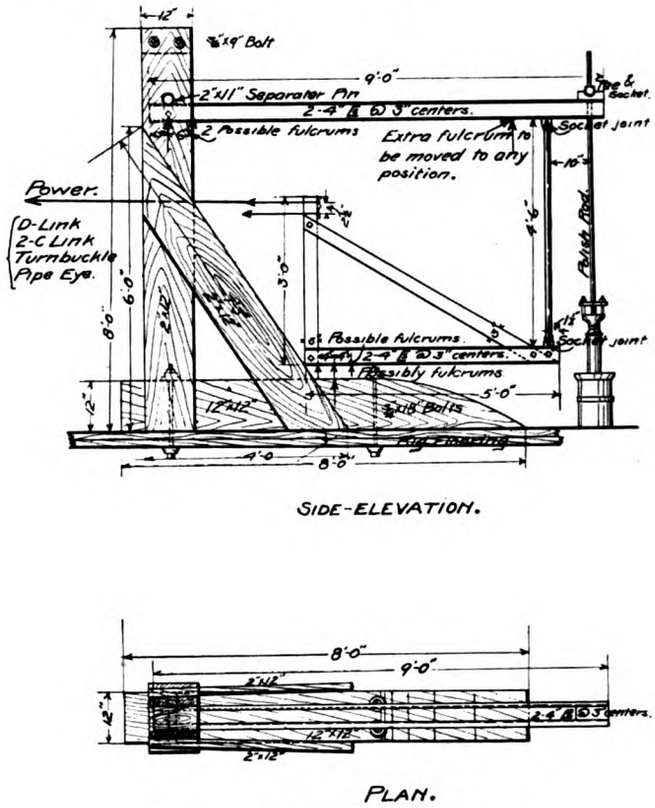

FIG. 11. OKLAHOMA PUMPING-JACK

The bill of material for an Oklahoma jack is as follows:

LUMBER		
One 12 by 12 in. by 8 ft., Oregon pine		
Two 2 by 12 in. by 16 ft., Oregon pine		
One 6 by 6 in. by 12 ft., Oregon pine	$5.70	
		$5.70
PUMPING-JACK		
One heavy California style Oklahoma jack	$42.00	
One Oklahoma polish-rod clamp	2.75	
		44.75
BOLTS AND WASHERS		
Four ¾ by 19-in. machine-bolts	0.75	
Two ¾ by 11-in. machine-bolts	0.16	
Eight ¾-in. cast washers	0.20	
Four ¾-in cut washers	0.02	
		1.13
CONNECTIONS		
One D-link	0.90	
Two C-links with link	2.30	
One turnbuckle	4.25	
One pipe-eye connection	1.15	
		8.70
Total material		$60.28
Total labor		5.50
Total cost		$65.78

The total weight is 1102 pounds.

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The Jones & Hammond jack transfers the horizontal to vertical motion acting merely as a triangle. The jack is built of tubular shapes. One of the supporting legs clamps around the casing-head, and the other is bolted to the derrick-floor or to a block. The connection may be either upper or lower, depending upon how it is desired to bring the shackle-line to the well. The lower connection is better because it is the stiffest. The bill of material is as follows:

LUMBER		
Two 6 by 8 in. by 4 ft., Oregon pine		
Two 2 by 6 in. by 4 ft., Oregon pine	1.40	
		$1.40
PUMPING-JACK		
One Jones & Hammond No. 3 jack, complete	$38.60	
		38.60
BOLTS AND WASHERS		
Four ¾ by 18-in., machine-bolts	0.75	
Three ¾ by 13-in. machine-bolts	0.36	
Eight ¾-in. cast washers	0.20	
Six ¾-in. cut washers	0.03	
		1.34
CONNECTIONS		
Two C-links with link	2.30	
One turnbuckle	4.25	
One pipe-eye	1.25	
		7.80
Total material		$49.14
Total labor		2.00
Total cost		$51.14

The total weight is 633 pounds.

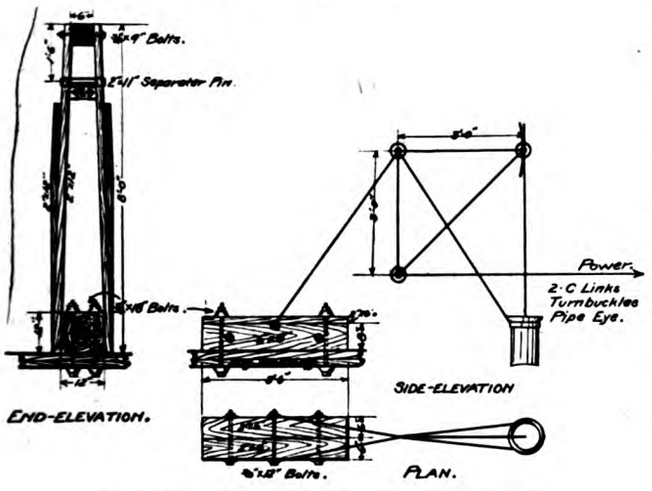

FIG. 12. JONES & HAMMOND PUMPING-JACK

The advantages of the Oklahoma jack as compared with the J & H jack are as follows:

1. It is easy to disconnect and lay aside during 'pulling' operations.

2. When the well 'sands up,' which is always on the up-stroke, the jack falls apart automatically, and there is no pounding.

3. The stroke can be regulated at the well.

On the other hand the J & H jack costs less to install and does not pull as hard as the Oklahoma jack. Also because the motion of the polish-rod is vertical, there is less wear on the stuffing-box. However, the Oklahoma jack has been found to be the best for heavy service.

Foundations for Line and Well-Structures. Oregon pine is not recommended for this work. In case it is used, all parts in contact with earth should be painted with oil, and buried in oil-sand or else earth moistened

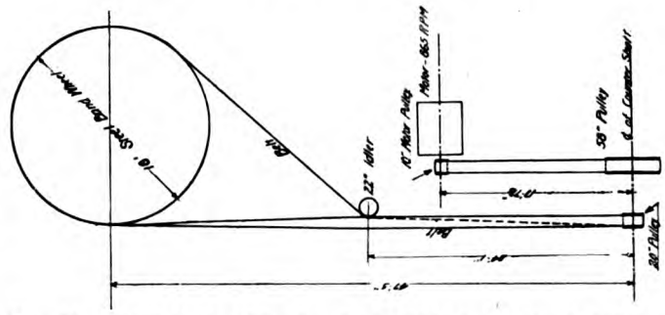

FIG. 13. GENERAL LAY-OUT OF MACHINERY FOR CENTRAL POWER-PLANT

with oil. Redwood may be used for the small foundation-sills of 2 by 12-in. timber. Cedar should be used for the larger timbers, and is really more economical than Oregon pine, because it does not require painting or other treatment. In some parts of the structures, such as the vertical posts, cedar may not be strong enough, and Oregon pine should be used in its place.

Length and Frequency of Stroke. The 'pound' in shackle-lines results from the downward motion of the plunger of the pump continuing after the line begins the back-stroke. In order to minimize this effect, the shortest and slowest stroke that will pump the well to its full capacity should be used. Decreasing the length of stroke also decreases the wear of the polish-rod against the stuffing-box. When the well is pumped too fast for its production the flow of oil will be intermittent and the oil will rise only part-way in the pump-barrel, making the plunger pound against the oil and gas cushion on the down-stroke. On the Nevada division of the General Petroleum Corporation, the frequency of stroke used is from 14½ to 16 per minute. On the Belridge division, 16 strokes per minute is the rule. The length of stroke on these properties varies from 14 to 24 in., and is based on a study of the individual wells.

The Nevada division of the General Petroleum Corporation is on 'Twenty-five Hill,' in the Midway field, near Taft. The jack-pumping plant was placed in operation in April 1915. Before that time the wells had been pumped on the beam by individual motors. This was the first large plant to be constructed in the Midway field, and the experience in the construction of this plant proved to be of considerable value in the construction of the Belridge plant, which was completed in July 1915. This is in the Belridge field, about 12 miles from McKittrick. The General Petroleum Corporation has a third plant now under construction at Lost Hills. The general characteristics of the three plants is shown in the accompanying table:

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	Nevada division	Belridge division	Lost Hills division
Topography	Rough	Smooth	Smooth
Number of wells	46	21	50
Number of jack-pumps	2	2	..
Number of central plants	3	1	3
Age of wells, years	4–7	3–5	1–6
Average depth of wells, ft.	1150	800	1200
Average depth to fluid, ft.	1150	720	....
Gas	Very little	Good pressure	Good pressure
Sand, per cent	0.0 to 1.8	0.1 to 18	small
Average gravity, Baumé	14	14 to 26	26 to 35
Av. production, bbl. per day	30	15 to 220	Av. 50
Length of lines, ft.	28,000	28,000	44,000
Throw-offs	48	23	50
Posts	928	1080	1760
Multipliers	96	16	130
Rockers and pendulums	44	..	2
Angles	10	5	10
Hold-outs	..	1	4
Hold-ins	..	1	..
Counter-balances	..	9	..

On both the Nevada and Belridge divisions, there was a considerable reduction in sand trouble after the plants were completed. Power consumption has also been reduced considerably as is shown by the following data. Power No. 1 at the Nevada division serves 18 wells and one jack-pump. A test soon after the plant was placed in operation showed a consumption of 2.2 hp. per well, and a cost for power of $0.394 per well per day, current costing $0.01 per kilowatt-hour. Power No. 2 serves 18 wells. The consumption was 2.6 hp. per well, and the cost $0.467 per well per day. Power No. 3 serves 10 wells and a jack-pump. The lines are long and the 'power' not well balanced, so the consumption of power is high, 3.5 hp. per well, and the cost is $0.625 per well per day. The average for all three powers was 2.45 hp. per well, and $0.438 per well per day for pumping alone. For pumping and pulling combined, the figures were 2.56 hp. and $0.458. When the wells were pumped on the beam, the cost of power per well per day was $1.05 and the average horse-power per well, 5.85, showing a saving of 56% by the use of a jack-pumping system. Since this test the consumption of power has been reduced considerably. Records for six months, covering both summer and winter conditions, show an average cost of power of $0.019 per barrel pumped. On the Belridge division, the average consumption of power is 1.59 kilowatt-hours per barrel pumped. In general it has been found in California that the average consumption of power per well per day is from 15 to 40 kilowatt-hours and per barrel pumped, 1.5 to 2.5 kilowatt-hours.

A jack-pumping system operated by gas-engines or electric motors will show a large reduction in cost over pumping the same wells on the beam by steam. Besides

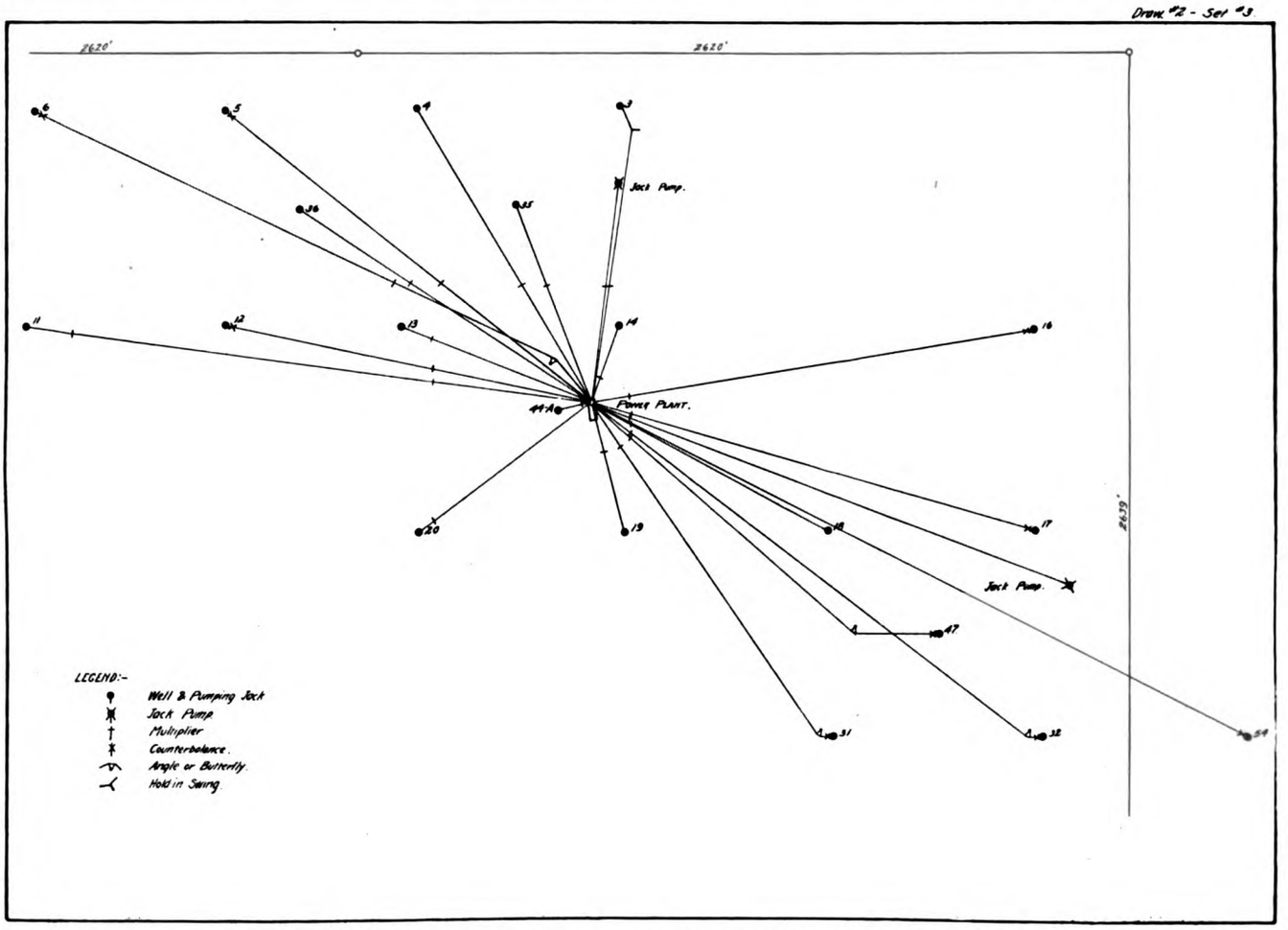

FIG. 14. MAP SHOWING GENERAL PETROLEUM CORPORATION'S PUMPING-JACK PLANT IN BELRIDGE OILFIELD

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the saving in power there is also a considerable reduction in labor costs. In general the construction of a jack-pumping system will reduce the total pumping cost at least 50%, as compared with individual installations at the well.

A portable outfit for pulling the wells is being used successfully in the Kern River field. This releases the equipment at the wells which is lying idle a large part of the time, such as the motor, gas-engine, or steam-engine, the rig-irons, and all of the lumber except that which is in the derrick.

Balancing the Load on the Central Power. Knowing the depth of each well, the size of the tubing and sucker-rods, and the gravity of the liquid to be pumped, the weight upon the plunger of the pump in each well can be computed. This weight must be lifted through a distance corresponding to the length of stroke of the plunger.

Assume that there is no motion in the system. This weight upon the plunger becomes a static load, causing a vertical force to be changed by means of the pumping-jack to a horizontal force. The point where the resultant of all the horizontal forces in the plant is zero can be determined by trial. This will determine a tentative position for the central plant.

The moment the central power is set in motion, friction increases the load in one direction and decreases it in the opposite direction. The components of this friction are as follows:

1. Friction at the pump. This may be estimated from previous knowledge of the well, whether it has been a hard or an easy pumper.

2. Friction at the pumping-jack. This may be estimated by assuming a friction factor.

3. Friction in the transmission line. This may also be estimated by assuming a friction factor.

Assuming that the central-power has a single eccentric disk, the frictional forces may be resolved along two co-ordinate axes and three or more points obtained by trial where the resultant of the forces is approximately zero. The power-plant should be placed at the most convenient position with reference to these points. The same method may be used with a double-disk power, since with the proper connection of the lines to the upper and lower eccentrics, all the friction forces will nearly balance each other, leaving only minor adjustments to be made after the plant was put in operation.

In general, when the topography is rough and the wells are in a compact group, it will be found advisable to choose a suitable position for the central plant as near the geographical centre of the wells as possible. Graphical methods will be found of value in determining the direction of the transmission-lines.

Where the wells are scattered, the point of zero resultant should first be determined, and the plant placed at the nearest suitable point. As before, graphical methods will be of assistance in designing the transmission system.

Where the topography is smooth and the wells are in a compact group the central plant should be placed as near as possible to the geographical centre of the group. Where the wells are scattered, graphical methods will be of use in determining the point of zero resultant.

In any case, some adjustment will be required after the plant is placed in operation. Where a motor is used for the power, the balancing of the well-loads may be done with a portable ammeter placed on the motor-circuit. The position of the power-head for maximum load is noted and the line-connections adjusted until the ammeter-dial maintains a constant position or varies at a uniform rate. Where a gas-engine is used, the final balancing is a matter of 'cut-and-try.'

An approximate estimate has been made of the cost of construction of a jack-pumping system. A fully developed oil-property with an area of 80 acres, ½ mile long and ¼ mile wide has been assumed. Smooth topography and three rows of seven wells each are also assumed, with a central power-plant near the centre of the property. It is also assumed that the wells were being pumped 'on the beam' by individual motors, and that these motors will be retained and used for cleaning operations.

Central plant	Labor	Material	Total
Building, 24 by 70 ft., corrugated galvanized iron, 8-ft. eaves	$110	$430	$540
One 40-hp. gas-engine, complete with clutch, governor, fittings, and starter.	100	1,380	1,380
National underpull power, with belt, belt-tightener, pull-rods, couplings, and pins	80	1,123	1,203
Concrete foundation for power and gas-engine, 1:3:5 mixture, 15 cu. yd.	175	70	245
Total central plant			$3,468
700 4 by 4-in. by 6-ft. posts	224	350	514
Lines, 19,000 ft. of old 1-in. cable, no charge for material	...	400	400
23 throw-off posts at $13	...	...	299
21 pendulum-multipliers, at $20.25	...	...	425
3 pendulums at $13.20	...	...	40
4 heavy butterflys, at $63	...	...	252
2 hold-out swings, at $46.20	...	...	92
6 counter-balance weights at $75.85	...	...	455
2 jack-pumps, at $62.60	...	...	125
21 Oklahoma jacks, complete, at $65.78	...	...	1,383
			$7,553

Including hauling, the total cost would be about $8000 or approximately $380 per well served. The total weight including materials for the concrete foundation, would be about 212,000 pounds.

Concrete streets in Macon, Georgia, are finished in an unusual way. Hollow iron rollers, 8 in. diam. and 4 to 8 ft. wide, with handles long enough to reach from the side of the pavement to the centre are run transversely on the pavement. For the final finishing after the surface is rolled, and before it has hardened, a 1-in. hose is dragged longitudinally over the surface by two men, one on each side of the pavement.

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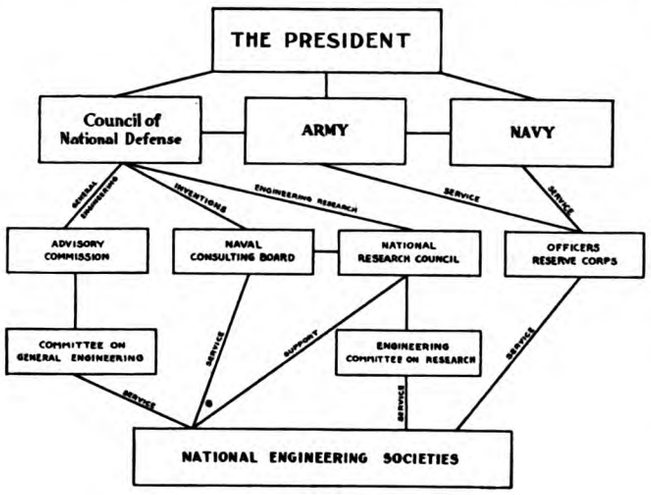
National Engineering Societies and National Service

The administrative organization for the conduct of the War is set forth on the accompanying diagram, showing the mechanism for the contributions to be made by the national engineering societies. This diagrammatic expression of the co-ordination of the engineering talent of the country was prepared by Philip N. Moore and Bradley Stoughton to show engineers through what channels their services might be made available. With the exception of the direct contribution to military and naval operation as trained specialists serving in the Officers' Reserve Corps, all civilian technical effort is finally co-ordinated for Government service through the Council of National Defense, which stands next to the President, and serves



WAR-ORGANIZATION OF ENGINEERING SOCIETIES

as his right hand in maintaining and utilizing the industrial competency of the Nation in this hour of crisis. The Council of National Defense is composed of four Cabinet Officers assisted by eight civilians, namely, Daniel Willard, chairman, president of the Baltimore & Ohio Railroad, Howard E. Coffin, an engineer of the highest ability and vice-president of the Hudson Motor Co., Dr. Hollis Godfrey of the Drexel Institute,, Samuel Gompers of the American Federation of Labor, Julius Rosenwald of Sears, Roebuck & Co., Bernard H. Baruch, a banker, Dr. Franklin H. Martin, and Grosvenor B. Clarkson, secretary to the Board.

The Advisory Commission of the Council of National Defense is composed of civilians who are chairmen of committees on Engineering, Finance, Agriculture, etc. Dr. Hollis Godfrey is a member also of the Advisory Commission and chairman of its Engineering Committee. The President and Secretary of the American Institute of Mining Engineers likewise have been appointed members of the Engineering Committee. This Committee articulates directly with the Council of National Defense on all matters of general engineering, and it calls upon the individual members and resources of the National Engineering Societies for service in connection with general engineering matters, not including inventions which belong in the field of the Naval Consulting Board, nor research which is looked after by the National Research Council.

THE NAVAL CONSULTING BOARD was appointed by the President of the United States upon nominations made by the National Engineering Societies and others. The American Institute of Mining Engineers is represented on that Board by W. L. Saunders, who serves as its chairman, and by Benjamin B. Thayer. Six other members of the A. I. M. E. are also members of the Naval Consulting Board. This Board articulates directly with the Council of National Defense and advises upon all questions having to do with the investigation and development of inventions for the use of the Army and Navy Departments and any other branch of the National service; it does not, however, articulate directly with the Government Departments, but reports to the Council of National Defense.

THE NATIONAL RESEARCH COUNCIL was formed by the National Academy of Sciences at the request of President Wilson. The National Academy of Sciences was formed during the Civil War for the purpose of assisting the Government. The National Research Council's organization and operating expenses, but not its research expenses, are paid by the Engineering Foundation, which is a creation of the United Engineering Society. The National Research Council co-operates with the Naval Consulting Board and the Council of National Defense in all matters having to do with research, but not with inventions nor with general engineering.

The American Institute of Mining Engineers is represented on the Engineering Committee of the National Research Council by Pope Yeatman and Albert Sauveur. Other members of the A. I. M. E. are also on this committee.

THE OFFICERS' RESERVE CORPS was developed by a Joint Conference Committee of the national engineering societies and became law by Act of Congress in July, 1916. Application-forms for a commission in the Officers' Reserve Corps, Department of Engineers, can be obtained from the War Department, Washington, D. C., or from the secretary of the American Institute of Mining Engineers.

It is desirable to obviate duplication of effort. Multiplicity of organizations throughout the country for patriotic service is a feature of the first impulse before riper experience shall have shown how they should be co-ordinated so as not to overlap and interfere. The State Geologists and the U. S. Geological Survey, for example, should arrange for a division of work in giving information concerning probable new sources of metals and in-

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dustrial minerals, so that each may do that for which it is best fitted. Several of the States, among which is California, have organized their own Councils of Defense, appointed by the Governors. An organization of this kind is practically certain to expend useless effort, unless its work be co-ordinated with the federal or national bureaus and committees. This is apparent to the members of these State Councils, and so far their efforts have been directed chiefly toward taking a census of resources, physical and other, which will necessarily be helpful to the Council of National Defense. The political motive back of the laws creating these local organizations seems to have developed out of the historic insistence upon State's rights. It is not to be condemned since it shows that the democratic spirit that is unwilling to relinquish too much of its authority to centralized control is still vital. It is well enough to keep the ideals of independent self-government in evidence; meanwhile it is to be hoped that the conception of responsibility for actual defense, as a movement apart from the Federal forces, be not taken too seriously. Local direction of production in harmony with the national requisitions, coupled with the maintenance of an effective rural police having wider jurisdiction than county officers, would render the State Councils a most useful aid to the general endeavor of national-committee work.

Automobile Stages in California*

With the exception of those operating entirely within incorporated cities and towns, companies and individuals running automobile stages in California must now file their rates, schedules, routes, etc., with the State Railroad Commission. There are now about 600 companies and individuals operating stages, from the man who drives his own car over but one route, to the Star Co. of Sacramento and Stockton, which operates stages over 17 different routes with an aggregate length of 654 miles, and the Western Auto Stage Co., which operates stages on 7 routes with an aggregate length of 1300 miles, including the through trip from San Francisco to Los Angeles by either the coast or the valley route.

A study of the rates indicates that the predominating factor in their determination has been the requirements of competition with other means of transportation. Thus where the stage competes directly with a steam or electric railroad the rate is usually the same as that charged by the railroad. In some instances the rate is appreciably lower than the railroad rate, but this is usually because travel by the railroad has advantages that the stage cannot offer. For instance the rate between San Francisco and Los Angeles is $2 less than that charged by the railroad, but the automobile trip takes two days, while the time by the railroad is from 14 to 20 hours. In other instances where the fare by stage is the lower, it is probably the result of competition, actual or threatened, from some rival stage company. On the other hand, there are some cases where the train-service is infrequent, and the stages make several trips during the day, where the stage-fare is somewhat higher than that charged by the railroad. In general, on the valley stage-lines, and where there is railroad competition, the rates range between 2½ and 4c. per mile. That these rates are remunerative at the present time is shown by the fact that many conservative business-men, men who understand fully about depreciation, interest, and the other items that the smaller operator sometimes overlooks, are investing money in automobile-stage lines. The principal drawback at the present time in the business is undoubtedly the unrestricted competition between rival stage-lines.

In the mountains and in other districts where there is no railroad competition, the rates are approximately the same as those formerly charged by the horse-drawn stages. Except in the higher mountains during the winter, when snow makes the roads impassable for automobiles, the horse-drawn stage has been practically eliminated. The rates charged are usually between 10 and 15c. per mile. It should be remembered, however, that most of these stages operate over poor roads with heavy grades. Where a stage competes with a railroad along part but not all of its route, the effect of the railroad competition is marked. For instance, on the line between Eureka and Crescent City, 102 miles in all, there is railroad competition for about one-third of the distance, and the rates on this part of the route are 4 to 5c. per mile. As soon as the end of the railroad is passed, the rates commence to rise and the fare for the entire 102 miles is $7.50, while the average rate over the part of the route where there is no railroad competition is 10c. per mile.

One of the stage-companies has adopted a free-baggage limit of 75 lb., but in most other cases, an extra charge is made for everything but hand-baggage. The stages operating away from the railroad appear to do a considerable baggage and express business.

*Staff article.

Silt observations on the Colorado river at the Yuma gauging-station are recorded in the *Reclamation Record*. The smallest discharge at this station during the past 14 years was 2750 second-feet, and the greatest was 220,000 second-feet. The maximum proportion of silt by weight, 1.2%, occurs when the discharge is about 26,000 second-feet. The velocity reaches the maximum at this point also, but remains nearly constant as the discharge increases, while the proportion of silt decreases until it is about 0.2% when the discharge is 200,000 second-feet. The weight of the wet silt per cubic foot is 86 lb. The specific gravity of the dried silt is 2.6.

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The Preparation of Specifications for Paving Materials

By CARL F. ADAM*

In these days of 'standards for everything,' a few words of caution to the municipality about to make its first venture in paving should need no apology. Too often we encounter the idea that the city engineer who has been chosen knows, if not everything, at least enough to write or compile a paving specification suitable for a small town. Fortunately, this conviction is sometimes justified. Usually, however, a mistaken sense of economy on the part of the trustees forces the engineer to rely almost wholly upon the work of others for his specifications, and therein is considerable danger.

It is far from my intention to belittle the value of the 'Standard Specification.' As a member of the Association for Standardizing Paving Specifications, now merged with the American Society of Municipal Improvements, I have even assisted in their construction. The Standard Specifications for Paving are capably drawn by engineers and specialists of wide experience; they serve admirably as a guide to a form that will invite and permit free and open competition; but they were never intended to be used literally, and the authors are the first to call attention to this fact. Having been drawn to cover every conceivable type of allowable material, every variety of climate and every condition of traffic, such specifications should never be used without considerable modification to adapt them to local conditions. Any engineer will admit that it is manifestly impossible to write paving specifications that will fit every case. One might as well predict success for a tailor who cuts all suits from one set of patterns. Also, it must be apparent even to a layman that the work of adapting specifications to local needs and adjusting the various technical details to fit a particular case is something that should not be left to inexperienced hands.

Let us consider, briefly, the use as a model of the specification that has been drawn orginally for another locality. It is true that many cities have gradually developed a form of specification that appears to work well under their particular conditions. Favorable local causes and suitable natural supplies, however, are often accidentally responsible for good results despite a weak specification. The fact, therefore, that a particular specification has resulted in work of a satisfactory character in one place does not prove it would be a good specification somewhere else. The chances are it will be a bad one. Granting the same climatic conditions, there may be differences in grade or slope, or in character of sub-grade, materials, and traffic, as well as in drainage. That a thorough knowledge of all these factors must precede the writing of a good specification is self evident and the engineer must do his best to secure it. When he is handicapped in his pursuit by a lack of the practical experience and special training necessary to solve correctly all the problems involved, he should be empowered to secure such aid as he needs. Failure to recognize the value of trained assistance is a common cause either of unsatisfactory work or of uneconomical, if not extravagant, design, and sometimes of both.

A case that came under my personal observation some years ago in a small California city serves to illustrate how borrowed specifications may work to the disadvantage of the property-owner. The first 'real' pavement (sheet-asphalt on cement-concrete base with a close binder) was to be laid. The city engineer, having had no previous experience with this class of work and being denied by the council the means to secure expert assistance, borrowed from a larger city specifications providing that one of the important ingredients of the pavement must be artificially prepared. Fearing to venture on untrodden paths, he specified that this artificial product be used. It was used in the construction despite the fact that a natural supply of similar suitable material of unusually fine quality could be obtained near at hand and was known to be available at half the cost. Had the local material been used a saving of nearly $0.18 per sq. yd., or $0.35 per front foot, would have resulted and the life of the pavement would have been in no wise shortened.

A prominent advertiser has stated: "Specifications are necessary things and deserve all the care that is spent upon them, but the final test of the desirability of a paving material is not found in any specification." It might be added that many things found in specifications are equally impotent in assuring desirability; but more of that later. The quotation is true in so far as it relates to an untried material, but the experienced engineer soon learns to discriminate, and his specifications will provide only for the use of materials of proved worth, as well as for economic design and sane construction. Whether he is dealing with pavements of stone, wood, or asphalt block; vitrified brick; sheet asphalt; cement or bituminous concrete; he will pursue a conservative course with regard to the materials of construction, at the same time endeavoring to avoid the exclusion of acceptable local materials.

Asphalt: Here on the Pacific Coast we are perhaps more interested in sheet-asphalt and asphalt-concrete pavements, at least for city streets, than in other types, because of the proximity and consequent cheapness of a natural supply of high-grade asphalt. Californian as-

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phalts, refined from natural liquid asphaltic bitumens, are excellent for paving when produced under expert laboratory-control. With a knowledge of what is required, therefore, it becomes a comparatively simple matter to specify a first-class asphalt with the assurance that it can be secured at the market rate. Four or five tests are all that it is necessary to prescribe to insure the rejection of unfit material. These and their objects may be briefly outlined as follows:

1. Penetration: To provide for proper consistence.

2. Ductility: To insure the possession of adequate cementing properties.

3. Loss on heating: To insure comparative absence of volatile constituents whose presence in excess might be a source of danger during construction and whose subsequent slow volatilization through atmospheric influences would tend to harden the pavement too much.

4. Penetration after heating: [supplementing Test No. 31] To determine to what degree the evaporation of volatiles and oxidation of the asphalt will result in hardening and to insure the rejection of material unfit in this particular.

5. Solubility in carbon tetrachloride: To insure comparative absence of decomposition products due to careless refining methods. Tests 3, 4, and 5 are all indicators of the degree of care used in producing the asphalt.

Tests for specific gravity, free carbon, fixed carbon, and solubility in naphtha may be interesting in an academic sense, and some of them are useful for purposes of identification, but they have no logical place in a Pacific Coast paving specification. In my opinion their inclusion merely adds useless complications without in any way furthering the real object of the specifications. So also with the time-honored test for solubility in carbon di-sulphide. Californian asphalts as now marketed are so nearly a pure bitumen (99.5% to 99.9%) that the carbon tetrachloride test discloses all that is needed in regard to purity and at the same time reveals another important fact. If at any time during the period of inspection the test for solubility of the asphalt in carbon tetrachloride should be so low that considered alone it would cause rejection of a shipment, the test for solubility in carbon di-sulphide may still be used to determine whether the rejection is justified because of the presence of an excess of 'carbenes' or whether the low solubility is simply the result of the presence of some comparatively harmless substance like silt. This situation is so unlikely to arise that in my opinion it is better for the sake of greater simplicity to omit the di-sulphide test from this section of the specifications.

I have noted in several specifications for paving materials, one quite recently, the emphatic admonition that the asphalt 'must be free from carbon' or words to that effect. In the name of common sense, how can any material be free from carbon and still be asphalt?

Another test, included now for some years, in many Eastern specifications is that for susceptibility to temperature-changes. It involves only the measure of penetration at 32° F. and at 115° F. in addition to the usual test at 77° F. This determination is of value in the selection of a pipe-dip or of a grouting-asphalt for block pavements, but with respect to asphalt pavements in a country blessed with an equable climate such as ours, the particular effect sought through this test is not so important as in the East and Middle West. In any case, it would best be secured by proper attention to the grading of the mineral aggregate. Furthermore it must be remembered that any decrease in the susceptibility of our asphalts to temperature-changes is accompanied by a corresponding decrease in cementing-power, the most important quality of any asphalt.

When it comes to prescribing the proportion of asphalt cement to be used in the paving-mixture the case is not so simple. The ideal proportion cannot be foretold exactly, and hence, can be only roughly approximated in the specifications. Usually this is done by limiting the permissible variations, though it is well known that with a properly graded sand, the lower limit on asphalt would probably yield too dry a mix and the upper limit a mixture too rich or 'sloppy.' In order to attain best results with the chosen materials the quantity of asphalt to be used must be based on

1. The purity of the asphalt
2. The grading of the mineral aggregate, and
3. The proportion of voids as determined after heating and mixing with the filler.

On the Pacific Coast the first factor is virtually a constant, but the other two are variable. Hence, during construction, the engineer must control the mixture by the making of pat-tests, by noting the appearance and behavior of the mixture in the mixer, in the truck, and on the street, as well as by laboratory analyses.

Stone: The character of the mineral aggregate deserves more attention than is found in some specifications. It is generally recognized that the stone to be used in making an asphaltic concrete should be reasonably hard and tough, that for the wearing surface it shall exhibit a low coefficient of wear, and that it shall be properly graded as to sizes. On the other hand, how often is there found any requirement calculated to exclude stone to whose surfaces the hot asphalt will adhere but imperfectly? Fortunately there are comparatively few types of stone that are otherwise acceptable, which would be barred on this account, but they do exist and the engineer who is striving for sure results will not neglect some reasonable requirement to cover the point.

Sand: Similar comments may be made in relation to sand but with even greater emphasis. Considering that fully 80% of a sheet-asphalt surface may be sand, the relative importance of this material is apparent. Asphalt concrete may contain from 30% to 40% of sand. Before drawing a specification for the sand permissible in the work a thorough search for, and investigation of, available sources of supply must be made for eco-

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nomic reasons as well as to obtain data for cost estimates. If local sands, alone or in combination, are found to meet the requirements, the allowable variations in grading may be stated with confidence that the cost of constructing the wearing-surface, and the binder course, if any, will be reasonable, and that the knowledge of these details on the part of all bidders alike without the need of separate and individual investigations will tend toward closer bidding. In the end the property-owner is taxed with the cost of only one investigation in place of several.

The principal points to be observed in specifying a sand for asphalt surfaces are known to engineers of experience in such work. They can be found in print, and are repeated here only to emphasize their importance. Briefly, they are:

1. The character of the material of which the sand-grains are composed.
2. The shape of the particles.
3. The relative proportion of different-sized grains.
4. The nature of their surfaces, or the degree to which hot asphalt will adhere to the grains.
5. The nature and proportion of impurities.

Unreasonable restrictions in these details are as much to be deplored as too much latitude. I have known cases where the requirements were so needlessly rigid that no sand to satisfy them could be found within a reasonable distance of the work. Aiming at an ideal is always commendable, but it is well, when firing, to remember that clamping the gun in a vise is a sure way to ruin the gun. A knowledge of how far it is safe to go, in a particular case, in departing from the ideal sand-grading, and skill in correcting natural deficiencies, are based on questions of traffic, climate, etc., and are learned only from experience.

Filler: In specifying the filler it is usual to demand either pulverized limestone or portland cement and to limit rejections on the 200-mesh and 100-mesh, or some lower number, sieves. No better materials than these are to be had, portland cement being recommended especially for heavy traffic. Invariably, however, much of the material that succeeds in passing the 200-mesh sieve is not 'dust' at all, that is, not really 'pulverized,' and hence of no more real value as a filler than so much fine sand. Such 'sand' is an expensive luxury. It is to the interest of the contractor as well as to that of the property-owner or municipality that the specification shall permit the presence of as little coarse or gritty material as it is practicable to obtain, and this is most effectively accomplished by requiring a reasonable minimum to pass the elutriation test.

Other components of the surface-mixture having been prescribed with due care, the final stability of the surface under varying conditions of traffic, moisture, temperature, etc., are assured only by intelligent selection and adequate use of the filler. Many unsatisfactory surfaces have resulted from the use of a filler which, though it complied in all particulars with the specified requirements, lacked in great measure the essentials of a proper filler, namely, true 'dust.' Of course, in this as with other materials, there is a limit of reasonableness beyond which the specifications may not go without heavily burdening the cost of construction.

Tests: It is now fairly well understood that the tests to which the materials of construction and the finished work are to be subjected as a necessary part of the inspection shall be clearly defined. They should be as few in number and as simple in detail as will best serve the end in view, and, where possible, had best include only tests or methods recommended by the American Society for Testing Materials or other organizations and individuals of recognized authority. The tests required should not be so few, however, as in the case of the paving specifications of one of the larger cities in the North-west, where, to save the situation, the city chemist frequently rejected shipments of asphalt through the use of a test that was not even mentioned in the specifications. I will not deny that the test was truly revealing, but its use in this case placed the city in the position of having asked for bids on a low-grade article and then allowed its inspector to enforce the delivery of a more expensive high-grade material. If a high-grade material is desired, the specifications should make the fact clear.

Complicated tests, or methods of testing, introduced at the suggestions of interested contractors or supplymen should never be adopted without the most searching scrutiny, and, if they add nothing to the value of the specifications, they should most certainly be omitted. The suspicion is inevitable that the object of these complications is either to exclude a competing material or to frighten competing bidders into raising their figures sufficiently to clear possible obstacles. Assuming the sufficiency of the tests finally prescribed, the fewer and simpler they are the more likely they are to be actually employed and the more thorough will be the inspection.

No matter how much has been written or printed on this and kindred subjects, and no matter how simple it all seems, it is well to remember that good results at lowest ultimate cost are assured only by the employment of experienced and competent advisors. In a recent report on the operations of the Department of Public Works of the city of Philadelphia, Morris L. Cooke, the department-head, says: "There is no cause which has contributed more to whatever measure of success has attended our work than the employment of experts." Commenting on this statement, the editor of *Engineering and Contracting* says, in part: "The effort of many municipalities to keep down expenses on public works * * * by engaging an engineer of inferior qualifications is a short-sighted policy. Questions are constantly arising which can be answered only by those who have had the peculiar experience in which the answering facts are developed. All such questions are being answered today more and more by the logic of facts rather than by personal opinion. It is to the expert that we must go to get these facts."

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Recent Developments in Aviation Engines*

By ALLISON F. H. SCOTT†

The gasoline aero-engine has been developed in four different types distinguishable by the arrangement of cylinders and valve-mechanism. These are (1) the vertical or ordinary automobile type with cylinders 'all-in-line,' (2) the revolving radial or rotary type with cylinder axes pointing toward a common centre, and with the cylinders and crank-case revolving as a solid piece, (3) the fixed radial or star type, with axes of the cylinders pointing toward a common centre and lying in a plane perpendicular to the engine-shaft, and (4) the diagonal or V-type with two sets of parallel cylinders at angles of 60° or 90° with each other.

One of the best examples of the first type of engine is the Mercedes-Daimler, vertical multiple-cylinder engine of solid and heavy construction, and yet of no striking originality. The distinctive features of this engine are reliability, simplicity, and accessibility. It is made in four, six, and eight cylinders, but in the German aerial service, in which over 80% are Mercedes-Daimler, the six-cylinder type is the favorite. The cylinder barrels of this engine are cast separately of a high-grade steel, and to these are welded the steel jackets necessary for water-cooling. The cylinders are attached to the crank-case by flanges, studs, and nuts. The pistons are of pressed steel with cast-iron rings. The connecting rods are of the usual I-section of chrome-nickel steel. The valves are inclined in the cylinder-heads, each driven by its own rocking-lever from an overhead enclosed cam-shaft, driven by a vertical spindle from the anti-propeller end of the crank-shaft. Ignition is provided by two carefully synchronized, high-tension Bosch magnetos. The cylinders are equipped with two spark-plugs, each set being fired by one magneto. There are two water-jacketed carbureters, each one supplying the mixture to three cylinders. These carbureters are of the two-jet type in which the fuel for the pilot-jet passes through a choke-tube. The air-intake on these machines is rather unusual in that it passes through the crank-case from right to left, following the bottom-surface of the crank-case shell. The bore of the 150-hp. engine is 5.51 in. and the stroke is 6.3 in. At 1250 r.p.m. this motor develops 150 hp. Its weight complete with the two magnetos, water and oil-pumps, piping, and oil-tank is 5.5 lb. per brake horse-power. With its long crank-case and crank-shaft it is a somewhat heavier engine for its power than the compact V-type. This disadvantage is offset, however, by the narrow end-aspect which offers little obstruction to the view of the pilot and by its adaptability to stream-line casing, which considerably reduces head resistance.

*Abstract from *The Wisconsin Engineer.*

†Engineer, The Gyro Co., Washington, D. C.

At present there are many prominent vertical engines, one of which, the Austro-Daimler, has given remarkable service in the present war. It is similar to the Mercedes-Daimler. At *BB,* Fig. 1, can be seen the two water-jacketed, annular-float feed single-spray, nozzle-type carbureters, identical in construction and adjustment, and each supplying three cylinders. The interchangeable cone-seated valves below *C* are each about one-half the cylinder-bore in throat-diameter and are inclined 30° to the vertical. The exhaust-valve seating and stem-guides

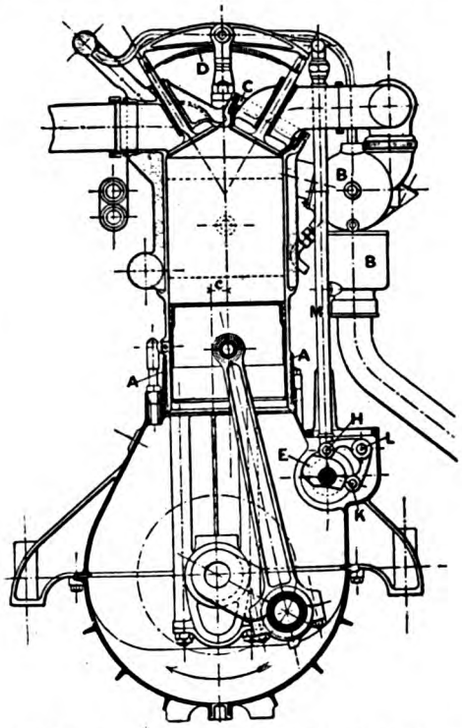

FIG. 1. AUSTRO-DAIMLER AEROPLANE ENGINE

are formed in the combustion-head casting and are also water-cooled. The inlet-valve on the right is in a separate casing fixed in one position by the removable hollow-flange nut *C*. If this cage is removed, the exhaust-valve on the left may be withdrawn. A single laminated spring *D* clamped at the centre on the fulcrum-post supporting the rocker-arms keeps the valves seated. A single push-rod positively operates both valves through the use of two cams in conjunction with a bell-crank lever. At *H* the tubular push-rod *M* is pin-connected to the bell-crank *HLK,* which is pivoted at *L*. The arms, however, are not co-planar as *LH* is behind *LK*. Cam *E* actuates roller *K,* and as it revolves clock-wise its plus-part strikes *K, M* descends, and the inlet-valve is opened. A similar cam behind *E* acts on *H,* the plus-part raises *M,* and thus opens the exhaust-valve. The diameter of the cylinder is 4.73 in. for the 90-hp. engine illustrated.

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In spite of its simplicity and fewer parts, the four-cylinder engine is not suitable for aeroplane service on account of its irregular torque and limited power-output. Recent improvements in the water-cooled six-cylinder machine, especially those directed to greater stiffness and consequent absence of torsional oscillations of the crank-shaft at high speed, make this type desirable for 75 to 150-hp. service.

The radial engine was selected by French engineers. Their efforts were directed toward developing air-cooled motors of both the fixed and rotary radial-type, for in these no other cooling-medium was employed than air, and the rotary type acts as its own fly-wheel. The radial-type is a development of the horizontal or opposed two-cylinder engine with two cranks diametrically opposed. It has excellent balance, with a working-stroke every revolution, but its cylinder arrangement makes it too bulky for actual service. A four-cylinder engine was built by M. Darracq having two impulses for every revolution. This type was soon modified by the addition of a second set of cylinders at right angles to the first, the eight cylinders furnishing four working strokes per revolution, and giving excellent balancing.

The reason for the popularity which the rotary type has enjoyed until recently has been the mechanical construction. The rotating cylinders are of chrome-nickel steel machined from solid ingots. The cooling-fins on the cylinder-exterior provide air cooling-surface. The working-barrels of the cylinder are less than $\frac{1}{16}$ in. thick, and great precautions against cylinder-distortion must therefore be taken. To lessen this distortion the cast-iron pistons are provided with two spring-rings, one of phosphor bronze of L-section and the other of cast-iron. The chrome-nickel steel connecting-rods are of I-section, and are pivoted to a cage. One of the rods, known as the master-rod, is rigidly fastened to the cage, which revolves once for each revolution of the cylinder. The length of the master-rod is such that the position of the cage is definite for carrying the pins of the remaining connecting-rods. Rotation of the cylinders is caused by the side-pressure of the pistons on the working-barrels that results from the connecting-rod's obliquity when the engine is running.

The crank-shaft is of chrome-nickel steel, made in two parts, which are fastened together at the crank-pin. Ignition is provided by a single high-tension magneto geared to rotate faster than the cylinders. The inlet-valve is situated at the centre of the piston-crown. Two counterpoises and a spring are used for adjustment of the valve and for overcoming the tendency to become unseated due to centrifugal force. The mixture is drawn in through the hollow crank-shaft and is thrown through the valve centrifugally as the valve is lifted from its seat. The exhaust takes place through a single cam-actuated valve in the head of each cylinder. Castor oil is fed with the gasoline for lubrication. Owing to the careful balancing of the engine, there is little vibration at even the relatively high speed of 1300 revolutions per minute.

The Salmson radial motor is made in both the horizontal and vertical types. The water-cooled cylinders are placed symmetrically about the crank-shaft, which is at right angles to their plane. All the connecting rods operate on one crank-pin. The cylinders are machined from the solid ingot and the barrels are but two millimetres in thickness. A centrifugal pump, geared to the crank-shaft, delivers the cooling-water to the lowest point of the bottom cylinder, and from there the water is forced to the next pair and so on until from the top cylinder it passes out to the radiator. The pistons are flat-topped and are of cast-iron. The nickel-steel valves are

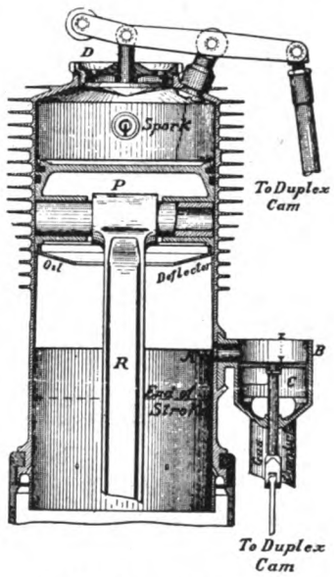

FIG. 2. GYRO ENGINE

of the cone-seated poppet type and are in the flat cylinder-head, each valve being operated through its own rocker, tappet, and push-rod. Each pair of inlet and exhaust valves is operated by the same cam. The crank-shaft is hollow, permitting forced lubrication to parts within the aluminum crank-case. This shaft is carried on self-aligning ball-bearings. The Bosch shield magneto is used for ignition purposes. These motors are made in seven and nine-cylinder types of 90 and 140 hp. Two sets of such groupings give the 14 and 18-cylinder engines of modern usage of 200 and 300 hp. and 3.3 and 4.1 lb. per brake horse-power respectively. In principle the fixed radial motor is superior in many respects to the rotary-cylinder engine. Its principal defects are improper cooling and frequent back-firing. Moreover, considerable power is lost in head-resistance and the imperfect balance of the motor.

A later design than the one described is the Monosoupape Gnome motor, which contains many refinements in the design of working-parts. By far the greatest departure is the elimination of the inlet-valve. As the piston begins to move down on the expansion-stroke, the exhaust-valve opens at such a time that, as the piston passes the inlet-ports in the barrel, the pressure within the cylinder equals the pressure within the crank-case. For about one-third of the next down or induction stroke,

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the exhaust valve remains open, allowing a charge of fresh air to be drawn into the cylinder. The exhaust-valve then closes, and as the piston passes the ports, the diminished pressure within the cylinder causes some of the rich mixture from the crank-case to enter. On the upstroke the gas is compressed and exploded, the cycle then being completed. Although this engine weighs only three pounds per brake horse-power, it has two distinct disadvantages. First, it cannot be operated for a long period of time because of overheating and the almost constant necessity for readjustment. Moreover, this requires skilled attendants, which is almost impossible for battlefield work. The second disadvantage is found in its extravagant gasoline and castor-oil consumption. The quantity of fuel required for several hours' flight often outweighs the motor itself.

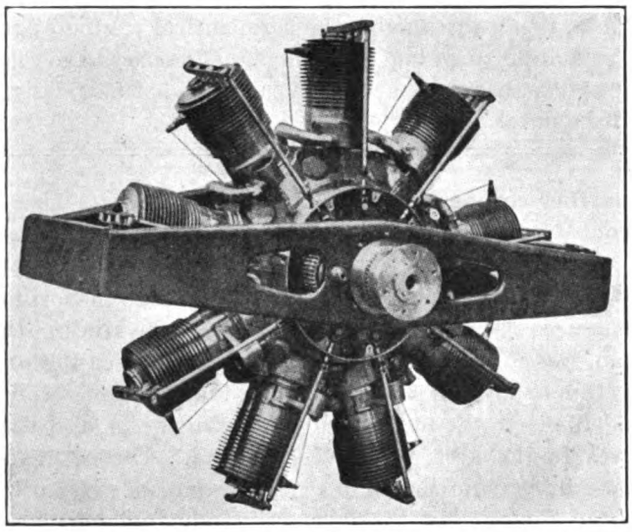

FIG. 3. FRONT VIEW OF NINE-CYLINDER GYRO ENGINE IN CRADLE

A successful rotary engine is made in the United States. This engine, the Gyro, is similar to the Gnome except that it has a duplex cam-actuated piston-valve working within a cylindrical casing which communicates with the cylinders through the ports, *AA*, Fig. 2, which the piston over-runs. The valve is connected to the crank-case by a gas-conduit through which super-carbureted air is thrown centrifugally. Fresh air is admitted through the exhaust-valve *D*, in the head, during part of the down-stroke. The valve is then closed, and the continued descent of the piston, creating a partial vacuum, draws in the live charge through the ports, *AA*, when over-run near the extremity of the stroke. After compression the charge is exploded, the main exhaust being through the head, since the piston-valve acts merely as an auxiliary means for exhaust. The periodic influx of fresh air through the main valve keeps it cool, although the piston-valve relieves it of the duty of discharging most of the hot gases. Another feature of the Gyro motor is a variable compression-cam, which allows easy starting and idling at 250 r.p.m. This motor, which weighs about 2.4 lb. per brake horse-power, is ideal for fast scouting-monoplanes, which must average from 90 to 100 miles per hour, and for reconnoisance work of short duration such as the marking of batteries, attacking weight-carrying machines, and use in short bombing-excursions, where a single shot through the radiator of a water-cooled engine would be disastrous.

The fixed-radial or star type of engine should be attributed to Anzani. Though the external appearance of this engine is the same, the star type, in distinction from the Gnome, has stationary cylinders and a revolving crank-shaft. The earliest development was a fan type, and the cylinders were all above a horizontal plane in order to avoid excessive lubrication of the cylinders. As lubrication difficulties were mastered and as vibration in the fan motor was great, the cylinders were symmetrically placed about the crank-shaft. As many as twenty cylinders are now used in two sets. The modern three-cylinder radial engine has its cylinders symmetrically arranged and its working impulses occur every 240° of crank-shaft revolution. By combining two such Y-type motors and using a crank-shaft of two throws, 180° apart, a six-cylinder engine of 45 hp. is obtained. By combining two sets of five radial cylinders each, a 10-cylinder machine of 100 hp. is produced, and similarly by doubling the 10-cylinder arrangements a 20-cylinder, two-throw crank engine of 200 hp. may be obtained. The Anzani engines of this type weigh 3.4 lb. per brake horse-power.

The V-type of motor adds to the advantages of the stationary-cylinder engine a double use of the crank-case metal. Light weight per horse-power output is the cardinal feature of the motor, which is of either the twin-four or the twin-six types. One of the latest motors still in the experimental stage is the Twin-six Packard, notable for its regularity of torque, high propeller efficiency, and absence of vibration. The cylinders are cast in blocks of three. Each cylinder is provided with two inlet and two exhaust-valves, set at 30° from the vertical, which provide 1 sq. in. of valve opening for 17 cu. in. of piston displacement. This displacement is for the 100-hp. engine. To each set of the three cylinders there is one cam-shaft, driven by a train of spur-gears from the crank-shaft. This cam-shaft actuates the valves through rockers pivoted on short shafts between the cam-shaft and the valve. This arrangement permits generous oiling of the cam-shaft and keeps the oil from the valve as well. A forked connecting-rod of I-section is used, along the shank of which runs an oil-tube carrying the lubricant to the piston-pin. The pistons are die-cast of aluminum alloy. The total weight including the piston-pin and four rings is only 11 oz. The crank-shaft has three bearings and is provided with a triangular web so strong that the shaft is completely free from 'whip' throughout the entire speed-range. The carbureters feed the gas to a separate straight header from which short pipes of equal length lead to each cylinder. Since the bend in the pipes offers resistance to the gas-flow, they have been placed so that they are in the same position with respect to the valves. The cooling-water is circulated by means of a gear-pump.

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Normal piston speed is about 1725 ft. per minute, although speeds as high as 3000 ft. per minute are readily obtained. This, of course, necessitates a geared-down propeller. At 2300 r.p.m. this motor delivers 100 hp. The weight per horse-power, including the cooling-water and radiator, is 5.9 lb. A 4-valve, 12-cylinder, 300-hp. engine is now being developed by the Packard experimental department and will soon be ready for actual use in the field.

Mufflers and mechanical starters must soon be considered as standard equipment for all engines. Mufflers are desirable as they relieve the aviator of much nervous strain resulting from the roar of the high-powered engines. The ingenious collector and muffler used on the latest Mercedes-Daimler apparently has solved the problem of a simple yet serviceable silencer. The necessity for muffling in military operations is obvious. Mechanical starters are invaluable in quick 'get-a-ways' in either enemy-territory or for easy starting in the air or on the ground. Compressed air, either applied directly to each cylinder or to a starter geared to the engine, has given good results. However, the trend in design is toward electric starting-equipment, which, with its generating outfit, makes lighting a possible future requirement. With greater thermal efficiency, obtainable at higher piston speeds, the question arises as to whether the propeller should be direct-connected or geared to the crank-shaft. With direct connection the propeller is limited to a speed of 1200 to 1400 r.p.m. in the fast light machines, and to 900 r.p.m. in the heavy weight-carrying biplanes. Thus the geared-down propeller seems best, as the severe gyroscopic stresses caused by the propeller are taken by a short lay-shaft rather than by the crank-shaft. Advantages claimed for geared-down propellers, given by one manufacturer, include compactness, giving small head-resistance, more uniform torque at the propeller, and maximum-power output without sacrificing propeller-efficiency. These enumerated features, however, will no doubt distinguish the aeronautical engine of the immediate future; but the changes of the past have come so rapidly that only the future can tell what new designs will be developed.

COSTS OF CONSTRUCTION AND OPERATION OF DIESEL-ENGINE PLANTS

A report presented at the convention of the National Electric Light Association contains the accompanying table of data regarding diesel-engine plants. The cost of diesel-engine plants, complete, with generators and all auxiliary equipment, will ordinarily range from a little over $100 per kilowatt capacity in large plants to $150 in small plants. Two plants in Texas, one of about 1000 and the other of 600 kilowatts capacity, cost, exclusive of the power-plant buildings, about $128 each per kilowatt capacity. Including buildings, the cost would be between $140 and $150 per kilowatt. The fuel consumption in a plant of moderate size is about 0.1 gallon per kilowatt-hour.

Oil production in California during 1916, according to figures recently compiled by the State Mining Bureau, was 87,063,195 bbl., or about the same as the production in 1915, in spite of the fact that drilling activity added 464 to the number of producing wells, and 6317 acres to the area of proved oil-land. The estimates made by private companies is somewhat more than the official figures, but the former include fuel burned in the field and make no allowance for water and other impurities in the oil when first produced and gauged in the field.

DATA ON DIESEL ENGINE PLANTS

NO	PLANT	H P OF ENGINES	KW OF GENERATORS	KW HOURS GENERATED PER YEAR	AVERAGE LOAD PER CENT OF RATED	FUEL OIL: SPECIFIC GRAVITY OR DEGREES BAUME AT 60°F	FUEL OIL: BTU PER LB	FUEL OIL: COST PER GALLON CENTS	FUEL OIL: GALS PER KW HR	FUEL OIL: COST PER KW HR MILLS	LUBRICATING OIL & WASTE COST PER KW HR MILLS	LABOR: NUMBER OF MEN	LABOR: COST PER KW HR MILLS	COST OF MAINTENANCE OR REPAIRS PER KW HOUR IN MILLS: ENGINES	ELECTRICAL EQUIPMENT	BLDG & FIXTURES	MISC	TOTAL	COST OF WATER PER KW HR MILLS	MISC COST PER KW HR MILLS	TOTAL OPERATING COST PER KW HR MILLS	REMARKS
1	MUNICIPAL PLANT SOUTH NORWALK, CONN	3-225	3-160	1,367,025 *1,102,755 1,469,760	231			3.56	105	3.72 3.46	7.92		5.13	3.66 3.41	1.47	4.37	5.64	4.56	4.88	2.64 2.620	17.31	*FISCAL YEAR OCT 1, 1911 - OCT 31, 1912 KW HRS GENERATED BY STEAM †DIESEL ENGINES ONLY ‡BASED ON TOTAL KW HRS *SUPPLIES *COAL MONTHLY FOR BANKED FIRES
2	DO	DO	DO	1,414,960 *197,550 1,612,510	23.9			5.13	1.27	6.50 5.75	1.17		4.81	3.75		7.28		4.48	5.37	3.96	20.7	*FISCAL YEAR OCT 1, 1913 - OCT 31, 1914 KW HRS GENERATED BY STEAM †DIESEL ENGINES ONLY ‡BASED ON TOTAL KW HRS INCLUDES SUPPLIES *INCLUDES ENGINES, BOILERS & GEN *COAL FOR STEAM ENGINES
3	PLANT AT ESTHERVILLE, IOWA	1-225		1,260*	23.4			2.86	1.26	3.61	7.78											*24 HOURS ELECTRICAL WORLD FEB 12 1916
4	PLANT IN SOUTH-WESTERN TOWN	3-250		63,760*				2.67	1.05	2.81			3.98	1.50	1.72		1.37	1.81	5.09	3.94	9.46	*ONE MONTH ONLY ELECTRICAL WORLD MAY 25 1912 - P 1121
5	DO	2-250		1,080,068						2.98	4.91		2.81	9.54		1.34	0.52*	1.14	0.47	0.24	7.49	*MISCELLANEOUS STATION EQUIPMENT ELECTRICAL WORLD, MAY 25 1912 - P 1121
6	NEW LONDON SHIP & ENGINE CO NEW LONDON, CONN.	1-200		2,613* 6,802	60.0 46.0			5.60 5.60	1.05 1.04	5.88 5.81	1.12 1.17		3.83 4.70									*AVE LOAD OF 18 KW FOR 331 HOURS DURING MONTH †AVE LOAD OF 61.5 KW FOR 10 HOURS DURING DEC 1912 ELECTRICAL WORLD, FEB 8, 1913 - P 349
7	MUNICIPAL PLANT, BELLEFONTAINE OHIO	1-225	2-92 KVA	1,851*	43.0			2.50	1.14	2.85												*24 HOURS, APRIL 1912 ELECTRICAL WORLD APL 27 1912 P 885
8	CENTRAL STATION, CLEBURNE, TEXAS	3-225	3-150	1,134,459	28.8	37*	16,000	3.00 TO 3.90	1.02	3.07	4.30	4	3.33	9.20			1.50	1.07	3.90	0.60*	8.34	*SUNDRIES & SUPPLIES THE CANADIAN ENGINEER JULY 10 1913
9	CENTRAL STATION SHERMAN, TEXAS	3-225	3-150	1,168,027	29.6	37*	16,000	2.50	1.02	2.55	4.07*	4	2.63	0.10				3.28	1.30		6.04	*INCLUDES SUNDRIES & SUPPLIES THE CANADIAN ENGINEER, JULY 10 1913
10	CENTRAL STATION, WINCHESTER, IND	2-225	2-200 KVA	320,640*	37.3	32* TO 34*		3.00	0.82	2.47	1.87*	3	1.82						0.86		4.57	*3 MONTHS ONLY †INCLUDES SUPPLIES POWER APRIL 27, 1915
11	CENTRAL STATION LEBANON IND.	1-125 2-225	63 KVA 60 "			30*	19,000	2.75	1.00	2.75	2.00	2*	1.90									*ALSO ONE HALF THE TIME OF ONE OTHER MAN ELECTRICAL WORLD DEC 2, 1911
12	CENTRAL STATION, PARIS, TEXAS	3-500	3-350	1,565,000*	51.0		19,600	3.22	0.95	3.07	0.40	6	1.44	0.40		0.50	1.50	2.40	0.90	1.00*	4.98	*SEPT 1 - DEC 31 1915 †OIL IS FILTERED & USED OVER AGAIN ‡MISC SUPPLIES & EXPENSES ELECTRICAL WORLD, MARCH 11, 1916
13	CENTRAL STATION, TYLER, TEXAS	4-225	4-150	499,000*	26.5	38.7*	19,500	3.28	1.57	5.18	5.60	4	2.24	4.48		0.50	6.10	5.14	1.90	2.90*	13.60	*SEPT 1 - DEC 31 1915 †MISC SUPPLIES & EXPENSES ELECTRICAL WORLD MARCH 11, 1916

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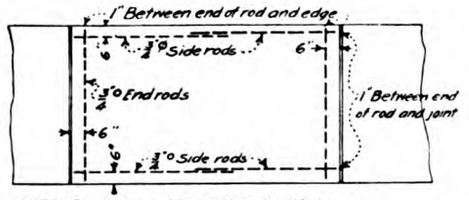
CIRCUMFERENTIAL REINFORCEMENT ON CONCRETE HIGHWAYS

Where cracks occur in a concrete slab they begin in most instances at the edge of the slab. Frequently they extend only a few feet. It has therefore been proposed that there should be a certain amount of reinforcement concentrated near the edge of the slabs. This has been designated a circumferential reinforcement. It may be used with or without other reinforcement.

All necessary details are shown in the accompanying diagram. While this form of reinforcement has not been tried in practice, it makes a strong appeal to all those engineers with whom it has been discussed and there should be little hesitancy in undertaking it. If it is to be used in an experimental way, it is suggested that the best method would be to reinforce every other slab, keeping a record of the slabs that were reinforced and those that were not.

This reinforcement should be particularly useful for pavements 20 ft. wide or more in addition to the usual mesh reinforcement.—*Concrete Highway Magazine.*



NOTE Reinforcement to be placed halfway between top and bottom of slab.

PORTLAND CEMENT ASSOCIATION
CHICAGO
Approved A N Johnson
Consulting Highway Engineer
Oct. 26 1916.

QUANTITIES AND LENGTHS OF $\frac{3}{8}$" ROUND RODS* FOR 1 CONCRETE SLAB.

DISTANCE BETWEEN JOINTS IN FEET	WIDTH OF ROAD IN FEET								
	18'			20'			24'		
	NUMBER AND LENGTH OF END PIECES	NUMBER AND LENGTH OF SIDE PIECES	TOTAL WEIGHT OF BOTH PER SLAB POUNDS	NUMBER AND LENGTH OF END PIECES	NUMBER AND LENGTH OF SIDE PIECES	TOTAL WEIGHT OF BOTH PER SLAB	NUMBER AND LENGTH OF END PIECES	NUMBER AND LENGTH OF SIDE PIECES	TOTAL WEIGHT OF BOTH PER SLAB POUNDS
25	2 18'-0"	2 25'-0"	129	2 20'-0"	2 25'-0"	135	2 24'-0"	2 25'-0"	147
35	2 18'-0"	2 35'-0"	159	2 20'-0"	2 35'-0"	165	2 24'-0"	2 35'-0"	177
40	2 18'-0"	4 21'-0"	180	2 20'-0"	4 21'-0"	186	2 24'-0"	4 21'-0"	198
50	2 18'-0"	4 26'-0"	210	2 20'-0"	4 26'-0"	216	2 24'-0"	4 26'-0"	228
75	2 18'-0"	6 26'-6"	293	2 20'-0"	6 26'-6"	299	2 24'-0"	6 26'-6"	311
100	2 18'-0"	8 26'-6"	372	2 20'-0"	8 26'-6"	378	2 24'-0"	8 26'-6"	390

* $\frac{3}{8}$" Bars may be substituted, reducing weights to 88$\frac{1}{2}$% of those shown

SKETCH OF REINFORCEMENT

Broken concrete from old pavement-bases has been used for aggregate for new concrete in Kansas City, according to an article in the *Engineering News-Record,* by C. R. Mandigo, formerly assistant city engineer. This procedure was followed in the replacement of a number of old pavements. On account of the expense of procuring new broken stone for aggregate, it was found that the cost of an 8-in. base using the broken concrete for aggregate was approximately the same as the cost of a 6-in. base using new broken stone. Comparative tests were made of samples of concrete using broken concrete for aggregate and using local limestone for the same purpose, and showed the two classes of concrete to be of approximately equal strength. It is probable that this can be partly explained by the greater care that would be likely to be used in work with the supposedly inferior aggregate.

Engineers' Note Book

TABLE FOR COMPUTING AMOUNT OF CEMENT NEEDED FOR OIL-WELLS

The following table taken from the annual report of the State Oil and Gas Supervisor gives the number of feet along the casing that will be filled by one sack of cement. For example: it is desired to set the 10-in. string of casing at a depth of 1230 ft. so that the cement will extend back to the 1200-ft. depth. It is estimated that the average diameter of the hole is 16¾ in. From the table, one sack of cement will fill 1.2 ft., so 25 sacks of cement will be required, plus an allowance for cement left inside the casing and below the casing.

LINEAL FEET FILLED BY ONE SACK OF PORTLAND CEMENT ALONGSIDE OF OIL-WELL CASINGS

(One sack equals 1.1 cu. ft. neat cement when set)

Size of casing		Diameter of well (excess over casing diameter)					
Nominal diameter Inches	Actual outside diameter Inches	One inch Feet	Two inches Feet	Three inches Feet	Four inches Feet	Five inches Feet	Six inches Feet
4½	4¾	19.2	8.8	5.4	3.7	2.8	2.8
4½	5	18.3	8.4	5.2	3.6	2.7	2.1
5⅝	6	15.5	7.1	4.4	3.2	2.4	1.9
6¼	6⅝	14.2	6.6	4.2	2.9	2.2	1.7
6½	7	13.5	6.3	4.0	2.8	2.1	1.7
7⅝	8	11.9	5.6	3.5	2.5	1.9	1.5
8½	8⅝	11.2	5.2	3.3	2.4	1.8	1.4
9⅝	10	9.7	4.6	2.9	2.1	1.6	1.3
10	10¾	9.0	4.3	2.8	2.0	1.5	1.2
11⅝	12	8.1	3.9	2.5	1.8	1.4	1.1
12½	13	7.5	3.6	2.3	1.7	1.3	1.0
13½	14	7.0	3.4	2.2	1.6	1.2	1.0
15½	16	6.1	3.0	1.9	1.4	1.1	0.9

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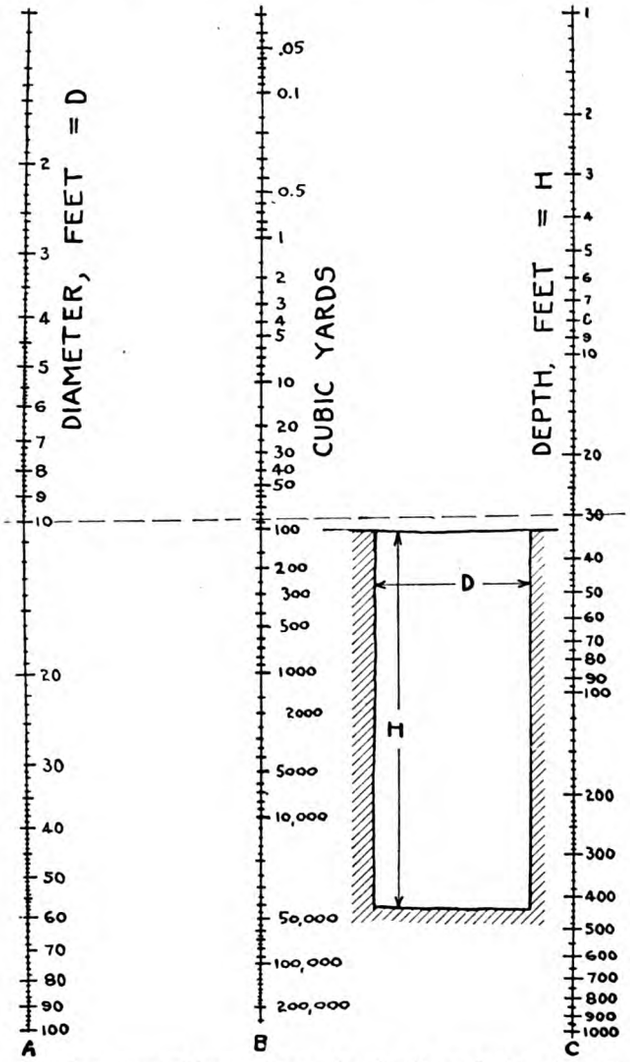
CHART FOR COMPUTING EARTHWORK IN EXCAVATIONS

The accompanying chart, taken from *The Excavating Engineer*, may be used for computing the amount of earthwork



in circular excavations, given the depth and the diameter. To use the chart lay a straight-edge between the given dimensions in columns *A* and *C*, and read the yardage on column *B*. Thus in a pit 10 ft. diam. and 30 ft. deep, there is a little less than 90 cu. yd. of excavation. A pit 8 ft. diam. and 10 ft. deep would contain nearly 20 cubic yards.

Book Reviews

NOTES ON MILITARY EXPLOSIVES. By Erasmus M. Weaver, Maj. Gen. U. S. A., Chief of Coast Artillery. Fourth edition. Pp. 328 + viii. Wiley & Sons, New York. For sale by the *Mining and Scientific Press*. Price, $3.25.

The author takes advantage of the exhaustion of the third edition of his well-known treatise to bring the work up to date by the inclusion of changes brought about by experience in the present European war. In his preface he says that the more important of these changes are the substitution of wood-pulp for cotton in the manufacture of nitro-cellulose explosives, and the fixation of the nitrogen of the air; that in general no new explosives have been introduced; that the field is limited to the nitro-cellulose series, the nitro-glycerine series, the nitro-benzene series, and the alkaline-metallic nitrate mixtures, singly or to a combination of two or more of these series with the others; that the great propellant explosive for guns continues to be nitro-cellulose alone, or in combination with nitro-glycerine; that the explosive for charging shells is definitely restricted to picric acid or its derivatives, and for submarine mines and torpedoes to tri-nitrotoluol (TNT), or to gun-cotton; that the old nitrate mixtures are limited to hand-grenades, rockets, and pyrotechnics.

To this edition has been added an essay by the Director of the Institute of Industrial Research, Washington, covering the basic chemical behavior of the four organic elements in all explosives.

Part I states briefly the fundamentals of chemistry, the more modern theories of the ultimate construction of matter being disposed of in a brief foot-note. Part II lists the various substances used in the manufacture of explosives and describes briefly their manufacture, their chemical and physical characteristics, and their actions. In part III the various explosives are classified for military purposes by their explosive phenomena, while in parts IV, V, and VI, the three principal classes of explosives are described in detail with respect to composition, manufacture, and behavior. Part VII treats of Service Tests, part VIII of storage of explosives, part IX of the handling of explosives, and part X of military demolitions.

In the appendices are tucked away some paragraphs of absorbing interest both to the professional student and to the lay seeker for information on this important subject. The Laboratory Notes are designed to start students by directing intelligent experimentation; the Government Rules for shipment of explosives have instructive value to all handlers of explosives; and the previously mentioned notes on the four organic elements contain also a description of the rôle played by the halogens, in gas-attacks, all of extraordinary interest at the present time. The chemistry of gas-bombs and gas-masks is briefly and clearly stated in untechnical language.

It is difficult to draw the line between those parts of the work most valuable to the scientist and to the soldier; for the thoughtful student-soldier will want to know all the brief theory herein set down, and the scientist should become interested in the practical handling and use of the finished product. Finally, the whole book is so simply and plainly written that even the general public may find much profit in a study of this work of an authority in the chemistry, manufacture, and practical handling in service of one of the most essential elements of warfare.—A. H. B.

USE OF WATER IN IRRIGATION. By Samuel Fortier. Second edition. Pp. 257. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

In the preparation of the second edition of this useful book, the chapter on measurement of water has been revised and a discussion of sewage irrigation added. There is also a complete new chapter on the use of water in foreign countries, giving a brief description of irrigation works and irrigation practice in different parts of the world. The book in general is primarily for the farmer rather than the engineer, but it will be useful to any engineer engaged in irrigation work, since without the successful employment of water, the most carefully planned irrigation projects would be useless. In general, the book deals with the handling of irrigation water after it has been delivered to the individual irrigator, other problems connected with irrigation being considered only incidentally. Moisture in soils, the preparation of land for irrigation, prevention of seepage, systems of irrigation as applied to staple crops, as well as many other problems that confront the irrigator are fully discussed. The book should be particularly valuable to the farmer who is without previous experience in irrigation.

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TIMBER FRAMING. By Henry D. Dewell. Pp. 272. Ill., index. *Mining and Scientific Press*, San Francisco. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

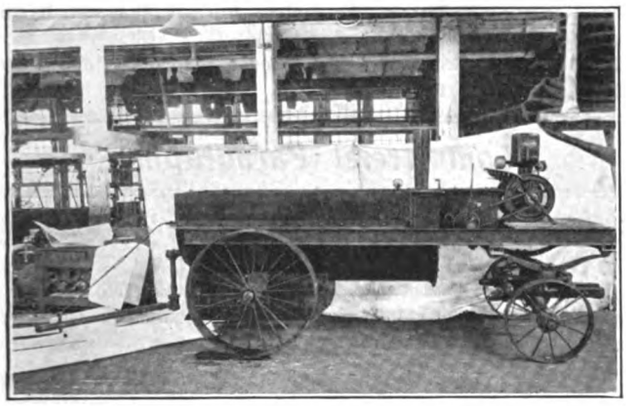
The series of articles that has appeared in WESTERN ENGINEERING during the past year have been revised and considerable new matter added, including the results of a number of different kinds of tests and a discussion of the design of ore-bins and head-frames by Robert S. Lewis of the University of Utah. The chapter on specifications has been entirely rewritten. The treatment throughout is practical, and the book will be of value to anyone who has to do with framing in timber.

WATER PURIFICATION. By Joseph W. Ellms. P. 477. Ill., index. The McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $5.

The progress made in methods of water purification in recent years, and particularly during the last decade, has been rapid, and the earlier treatises on the subject have become inadequate. The present volume commences with a general discussion of the sanitary aspect of water supplies and their purification. Sedimentation, slow sand-filtration, rapid sand-filtration, and disinfection either by chlorine, hypochlorite, or ozone, are then considered in turn. The treatment of rapid filtration is particularly thorough, nearly four times as much space being devoted to it as to slow filtration. The removal of dissolved mineral matter, either for industrial purposes or for drinking, is next discussed. The final chapter considers the control of water-purification processes. Throughout the book both the construction and operation of the various types of purification-plants is discussed, and a large amount of cost data is also given. The book will be of great value to the sanitary engineer.

Industrial Progress

The KINNEY MANUFACTURING CO. has replaced entirely its former line of horse-drawn asphalt heaters and distributers with its Handy heater and sprayer. One model of this machine, the 400-gallon size, is adapted for handling 'skin coat' or penetration construction work, having a large-capacity engine and pump, spray-bar, and seat for driver. It can be used either with horses or as a trailer behind a truck or road-roller. For handling patch-work and small jobs, this machine retains all of the advantages of the spray-hose models already adopted by the Highway Commissions of Massachusetts, Pennsylvania, Rhode Island, and New Hampshire. No steam is required, and it applies the heaviest grades of asphaltum as well as road-oil. The machine may be loaded with barrel material or is also self-loading from a tank or pit.



THE KINNEY HEATER AND SPRAYER

Civil Service Examinations

CALIFORNIA STATE CIVIL SERVICE COMMISSION.

ENGINEERING ASSISTANT, State Board of Health, July 7. Salary, $1200. Graduation from a technical school and a general knowledge of sanitary engineering required. Age limit, 21 to 60. Application form No. 2, which must be filed with the commission at Sacramento by June 30.

STRUCTURAL DRAFTSMAN AND JUNIOR STRUCTURAL DRAFTSMAN, June 15-16. Salaries, $1200 to $1800 for structural draftsman and $900 to $1200 for junior structural draftsman. Three years' experience required for structural draftsman and two years' for junior. Graduation from technical school considered equal to two years' experience. Age limits, 21 to 60 and 18 to 60. Application form No. 2 must be filed by June 9.

ENGINEER, STATE WATER COMMISSION, June 16. Salary, $2400 to $3000. Skill in hydrographic work and six years' of engineering experience required. Age limit, over 25. Application form No. 2 must be filed by June 9.

UNITED STATES CIVIL SERVICE COMMISSION

ASSISTANT CHEMICAL ENGINEER (Petroleum), Bureau of Mines, June 12. Salary, $1800 to $2100. Graduation in chemistry or chemical engineering from technical school and two years' experience with petroleum or oil-shale required. Age limit, under 40. Applicants will not be assembled for examination. Application form 2118.

ASSISTANT SHOP SUPERINTENDENT (Tool-Designer), June 12. Salary, $6 per day. Common-school education and two years' experience in similar positions required. Age limit, over 25. Applicants will not be assembled for examination.

ASSOCIATE ANALYTICAL CHEMIST, Bureau of Standards, June 19. Salary, $2500. Graduation with Ph.D. degree in chemistry and two years' experience in research work required. Age limit, 30 to 45. Applicants will not be assembled for examination. Application form 2118.

Engineering Societies

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. J. A. Currey, secretary, 194 North 13th street, Portland.

San Francisco Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carl F. Braun, secretary, Hooker & Lent building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Wilkie Woodard, secretary, 435 Consolidated Realty building, Los Angeles.

UTAH SOCIETY OF ENGINEERS. Hugh C. Lewis, secretary, Capitol building, Salt Lake City, Utah.

The annual meeting of the UTAH SOCIETY OF ENGINEERS was held at Salt Lake City on May 16. The speakers were Simon

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Bamberger, governor of Utah, Sylvester Q. Cannon, city engineer of Salt Lake City, and A. N. McKay, general manager for the *Salt Lake Tribune*.

The regular meeting of the IDAHO SOCIETY OF ENGINEERS was held at Boise on May 19. W. T. Wallace addressed the society on 'Public Utilities.'

The first regular meeting of the NORTHWESTERN SOCIETY OF HIGHWAY ENGINEERS was held at Portland on May 12. An organization was perfected and it was decided to hold quarterly meetings, the next one to be on July 14. The officers are: president, O. Laurgaard; vice-presidents, R. B. Murdock, R. M. Gillis, S. N. Graf; secretary, C. G. Reiter; treasurer, J. J. Brooks; directors, H. E. Abry, C. H. Whitmore, J. A. Elliott, George McGee, and C. M. Thomas.

The ENGINEERS' CLUB of Sacramento, California, was organized recently. The executive committee is composed of P. M. Norboe, George R. Winslow, S. W. Curtiss, E. M. MacKusick, George S. Nickerson, J. A. Givan, and Clifton H. Wildman. At the request of the Chamber of Commerce the club is to make a study of the city's water-supply problems.

Coming Conventions

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, Atlantic City, New Jersey, June 26-30.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Semi-annual meeting, Buffalo, New York, June 20-22. J. C. Olsen, secretary, Copper Union, New York.

Personal

J. O. BORRESEN has been appointed assistant State highway engineer of Utah.

C. E. JOHNSON has been appointed city engineer of San Bernardino, California.

E. C. EATON has been appointed resident engineer for the Lindsay-Strathmore irrigation district.

W. L. WALKER has opened offices in the First National Bank Bdg., Denver, as petroleum and mining geologist.

WILLIAM HOOD, chief engineer for the Southern Pacific Company, completed fifty years of service with that company on May 3, 1917.

R. K. WEST, formerly assistant engineer for the California State Highway Commission, has been appointed State highway engineer of Nevada.

JAMES K. JAMES has resigned his position as resident engineer for the Kern Trading & Oil Co. in order to join the Engineers' Reserve Corps.

ARNOLD T. BROWN, formerly assistant engineer for the Anderson-Cottonwood irrigation district, has resigned in order to engage in private practice.

C. E. TAIT, of the U. S. Office of Public Roads and Rural Engineering, has been making an investigation of irrigation systems in Fresno county, California.

A. T. MERCIER, formerly division engineer for the Southern Pacific Co., has been appointed assistant superintendent with headquarters at Dunsmuir, California.

F. A. POST-NIKOV has been appointed first lieutenant in the aviation section, signal corps, U. S. A. Mr. Post-nikov was formerly a lieutenant in the Russian army.

E. H. BALDWIN, formerly senior engineer of the U. S. Reclamation Service, has resigned to become chief of field forces in South America for Guggenheim Brothers.

J. C. NORTH and SHIRLEY BRIGHT have been appointed consulting engineers to assist BYRON LOVELACE in supervising the construction of the highway system of Tulare county, California.

GRANT LORRAINE, formerly city engineer of Orland, has been appointed city manager of Alhambra, California, succeeding CHARLES E. HEWES, who resigned to become city manager of Alameda.

THOMAS ADDISION, Pacific Coast manager for the General Electric Co., addressed the members of the Engineers' Club of San Francisco, May 24, on 'General Impressions as to War Conditions.'

CLARENCE MURRAY has been appointed city engineer of Fresno, succeeding C. C. VAN VALKENBURGH, JR. W. F. RANTSMA has been appointed deputy city engineer, succeeding R. W. FISHER.

Brigadier-General J. W. STEWART, formerly of the contracting firm of Foley Bros., Welch & Stewart, of Vancouver, B. C. and Spokane, Washington, is now 'somewhere in France', and was recently mentioned in dispatches.

A committee of architects, composed of WALTER BLISS, WILLIAM MOOSER, and GEORGE W. KELHAM, of San Francisco, has been appointed to supervise the construction of all naval buildings on the Pacific Coast, in the Philippines, and in Honolulu, during the War.

MAX THELEN, president of the State Railroad Commission of California, DAVID M. FOLSOM, of Stanford University, and ELLIOT BLACKWELDER of the University of Illinois are making an investigation of the petroleum situation in California at the request of the State Council of Defense.

During the absence of CHARLES H. LEE from his office in connection with his duties as a member of the Engineer Officers' Reserve Corps, his practice will be directed by W. K. BARNARD. Mr. Lee's offices in the Central Bdg., Los Angeles, will remain open in the immediate charge of RAYMOND MATTHEW, and under the general direction of Mr. Barnard.

Captain CHARLES T. LEEDS has been assigned to active duty in charge of the U. S. District Engineer Office at Los Angeles. The Chief of Engineers has granted permission for the continuation of the business of the firm of Leeds & Barnard under that name. All active work will be handled by Mr. Barnard, in consultation with Captain Leeds only in matters which do not touch upon his duties as Engineer Officer.

The following Pacific Coast engineers have recently received commissions in the Officers' Reserve Corps: Majors: D. P. FULLERTON, San Francisco, and GEORGE P. ROBINSON, Los Angeles. Captains: EDWARD L. MAYBERRY, Los Angeles; RALPH S. TWOGOOD, Berkeley; ALBERT A. PETERS, San Luis Obispo; ARTHUR L. ENGER, Tucson; ORMAN N. POWELL, Albuquerque. First lieutenants: WILLIAM P. BELCHER, San Francisco; RAYMOND F. BRALY, San Pedro; JOHN A. WATSON, Bremerton; ALBERT F. CHITTENDEN, Seattle; G. F. GOODSPEED, Corvallis; RICHARD T. EVANS, Sacramento. Second lieutenant: C. F. TOKLAS, San Francisco.

Commercial Paragraphs

The Excavating Engineer, of South Milwaukee, Wisconsin, has suspended publication until after the War.

The GENERAL ELECTRIC CO. has issued bulletin No. 43503, a 36-page pamphlet on 'The Application of Novalux Units to Ornamental Street-Lighting.'

The PENNSYLVANIA FLEXIBLE METALLIC TUBING CO., of Chicago and Philadelphia, has issued a 32-page pamphlet describing the metallic hose manufactured by the company.

The WATERLOO CEMENT MACHINERY CORPORATION, of Waterloo, Iowa, has issued a 48-page pamphlet describing the concrete-mixers and other construction equipment manufactured by the company.

C. F. BRAUN & CO., of San Francisco, have issued a general catalogue comprising their bulletins 11-A to 24, describing the Braun feed-water and service heaters, oil-heaters and oil-coolers, evaporators and distillers, condensing-apparatus, cooling-towers, and other apparatus manufactured by the company.

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SAN FRANCISCO, JUNE 4, 1917

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Contracts Pending

Bids will be Received		See Issue of News Bulletin
June 4.	Calipatria, Cal., Water Supply	June 4
June 4.	Fresno, Cal., Sewer	May 28
June 4.	Fresno, Cal., Street Work	May 28
June 4.	Hemet, Cal., Street Work	June 4
June 4.	Hollister, Cal., Bridge	May 21
June 4.	Las Vegas, Nev., Building	June 4
June 4.	Los Angeles, Cal., Sewer	May 28
June 4.	Los Angeles, Cal., Sewers	June 4
June 4.	Los Angeles, Cal., Street Work	June 4
June 4.	McMinnville, Cal., Water Supply	May 28
June 4.	Newport Beach, Cal., Harbor Work	May 21
June 4.	Newport, Wash., Road Work	June 4
June 4.	Olympia, Wash., Bridge	May 14
June 4.	Olympia, Wash., Road Work	May 14
June 4.	Ontario, Cal., Miscellaneous	June 4
June 4.	Placerville, Cal., Miscellaneous	May 21
June 4.	Redwood City, Cal., Water Supply	May 14
June 4.	Richmond, Cal., Sewers	June 4
June 4.	Ritzville, Wash., Street Work	May 28
June 4.	Sacramento, Cal., Road Work	May 14
June 4.	Sacramento, Cal., Road Work	May 28
June 4.	San Andreas, Cal., Bridges	May 21
June 4.	San Bernardino, Cal., Supplies	June 4
June 4.	San Rafael, Cal., Miscellaneous	June 4
June 4.	Santa Barbara, Cal., Bridges	May 28
June 4.	Santa Barbara, Cal., Building	June 4
June 4.	Santa Barbara, Cal., Miscellaneous	May 21
June 4.	Santa Barbara, Cal., Road Work	May 21
June 4.	Shelton, Wash., Road Work	June 4
June 4.	Vancouver, Wash., Bridges	May 28
June 4.	Ventura, Cal., Culvert	May 28
June 4.	Woodland, Cal., Street Work	May 14
June 5.	Bakersfield, Cal., Light	May 21
June 5.	Calexico, Cal., Machinery	June 4
June 5.	Clifton, Ariz., Building	May 21
June 5.	Kelso, Wash., Road Work	June 4
June 5.	Mt. Vernon, Wash., Bridge	May 21
June 5.	Port Angeles, Wash., Street Work	June 4
June 5.	Port Orchard, Wash., Bridge	May 21
June 5.	Port Orchard, Wash., Bridge	May 28
June 5.	Sacramento, Cal., Road Work	May 28
June 5.	Stockton, Cal., Street Work	May 21
June 5.	Visalia, Cal., Road Work	May 21
June 5.	Visalia, Cal., Road Work	June 4
June 5.	Washington, D. C., Supplies	May 21
June 5.	Washington, D. C., Supplies	May 28
June 5.	Watts, Cal., Street Work	June 4
June 6.	Fort Laramie, Wyo., Irrigation	May 21
June 6.	Kalama, Wash., Road Work	May 28
June 6.	Mill Valley, Cal., Street Work	May 28
June 6.	Portland, Ore., Bridge	May 21
June 6.	San Francisco, Cal., Building	May 28
June 6.	Santa Monica, Cal., Supplies	June 4
June 6.	Seattle, Wash., Supplies	June 4
June 6.	Terry, Mont., Sewer	June 4
June 6.	Washington, D. C., Buildings	May 21
June 7.	Coquille, Ore., Bridges	May 21
June 7.	Napa, Cal., Road Work	May 28
June 7.	Napa, Cal., Supplies	June 4
June 7.	Rio Vista, Cal., Street Work	May 28
June 7.	Roseburg, Ore., Road Work	May 21
June 7.	San Rafael, Cal., Water Supply	June 4
June 7.	Santa Barbara, Cal., Sewers	June 4
June 7.	Santa Barbara, Cal., Street Work	June 4
June 8.	San Francisco, Cal., Street Work	June 4
June 8.	Seattle, Wash., Supplies	June 4
June 8.	South Bend, Wash., Road Work	May 28
June 8.	Vancouver, Wash., Bridge	June 4
June 9.	Colville, Wash., Bridge	June 4
June 9.	Washington, D. C., Supplies	May 28
June 11.	Daly City, Cal., Street Work	May 28
June 11.	Modesto, Cal., Road Work	May 21
June 11.	Olympia, Wash., Road Work	May 28
June 11.	Seattle, Wash., Road Work	May 21
June 12.	Manteca, Cal., Water Supply	May 21
June 12.	Red Bluff, Cal., Street Work	May 28
June 12.	Washington, D. C., Machinery	June 4
June 12.	Yuma, Ariz., Sewers	May 28
June 12.	Yuma, Ariz., Street Work	June 4
June 13.	Eugene, Ore., Building	June 4
June 13.	Napa, Cal., Miscellaneous	May 14
June 13.	Washington, D. C., Buildings	May 21
June 14.	Oakland, Cal., Miscellaneous	June 4
June 14.	Santa Rosa, Cal., Bridge	May 28
June 14.	Washington, D. C., Bridge	May 21
June 15.	Washington, D. C., Supplies	June 4
June 15.	Winlock, Wash., Bridge	June 4
June 18.	San Diego, Cal., Bridges	May 28
June 19.	Salt Lake City, Utah, Sewers	June 4
June 19.	Salt Lake City, Utah, Street Work	June 4
June 19.	Seattle, Wash., Bridge	June 4
June 23.	Wickenburg, Ariz., Light	June 4
June 23.	Wickenburg, Ariz., Water Supply	June 4
June 25.	Clifton, Ariz., Bridge	June 4
June 28.	Salinas, Cal., Drainage	June 4

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Construction News

STREET AND ROAD WORK

BAKERSFIELD, CAL.—Contract for construction of highway from McFarland to Wasco, requiring 10.8 miles of concrete pavement, has been awarded to George S. Benson & Sons, Stimson Bdg., Los Angeles, for $44,548.15. Other bidders were: Mesmer & Rice, $46,845.20; J. H. Schafer, $46,967.95; L. G. Garnsey, $49,887.20.

Contract for construction of Weed Patch Loop highway, comprising 8.31 miles of concrete pavement, has been awarded to L. G. Garnsey, Central Bdg., Los Angeles, for $68,780.45. Other bidders were: George S. Benson & Sons, $69,973.40; M. T. Schafer, $73,335.10; Mesmer & Rice, $81,573.50.

BELLINGHAM, WASH.—All bids for construction of Geneva highway have been rejected because too high, and work will be re-advertised.

Contract for construction of 12 miles of concrete pavement on Northeast Diagonal highway has been awarded to Washington Paving Co., Smith Bdg., Seattle, for $192,000.

Contract for construction of East Hoquiam highway has been awarded to Ralph Henry, Aberdeen, for $12,776.

CLIFTON, ARIZ.—Bond issue of $200,000 for construction of highways has been voted.

EUREKA, CAL.—State Highway Commission has decided to construct state highway between Eureka and Arcata by the marsh route. This will necessitate the construction of a bridge across Eureka slough by the county.

FAIRFIELD, CAL.—Highway work proposed in Third road district comprises 22 miles of concrete road and 3 miles of oil-macadam road. Estimated cost is $284,000.

HEMET, CAL.—Bids will be received until 7:30 p.m., June 4, by C. M. Dietterich, city clerk, for construction of oil and screenings wearing surface on several streets.

HOQUIAM, WASH.—Contract for paving 2¼ miles of highway between Montesano and Aberdeen has been awarded to Grays Harbor Construction Co., Hoquiam, for $40,426.40.

KELSO, WASH.—Bids will be received until June 5 by county commissioners for improvement of three miles of permanent highway No. 3.

Sub-contract for making fill across Kalama River bottoms on Pacific highway has been awarded to Burcham Bros., Kelso. Work comprises 25,000 cu. yd. embankment.

LOS ANGELES, CAL.—Board of Public Works will receive bids until 10 a.m., June 4, for construction of asphalt pavement, concrete curbs and sidewalks, and granite-block and concrete gutters for several blocks on Hoover street.

Bids will also be received until the same time for construction of concrete and asphalt pavement, concrete curbs, and granite-block gutters on Atlantic street.

Contract for improvement of Oregon street has been awarded to M. T. Shafer, 220 West 33rd street, Los Angeles, for $4487.84.

Contract for improvement of Hope street has been awarded to Bryant & Austin, 1656 Compton avenue, Los Angeles, for $7012.21.

Contract for improvement of Railroad street has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $4462.01.

NAPA, CAL.—Contract for construction of concrete sidewalks and curbs has been awarded to G. Gaggero at $0.325 per ft. for curbs and $0.115 for sidewalks. Gildersleeve Contracting Co. bid $0.325 and $0.1225.

NEWPORT, WASH.—Bids will be received until June 4 by S. M. McGee, county clerk, for construction of permanent highway No. 4-A.

PORT ANGELES, WASH.—Bids will be received until June 5 by J. L. Beam, city clerk, for improvement of 8th street.

SACRAMENTO, CAL.—Following were the low bidders for state highway work: In Yolo county, undergrade crossing at Davis, including 1200 lin. ft. of concrete pavement, T. M. Olney, 358 Vernon avenue, Oakland, $13,600. In Santa Barbara county, from Zaca station to Los Alamos, 9 miles to be paved with concrete, W. A. Dontanville, Salinas, $63,084. In Tulare county, from Visalia to Tulare, 9 miles to be paved with concrete, J. H. Shafer, Los Angeles, $46,265.50. In Solano county, from Batavia to Putah creek, 84 miles to be paved with concrete, T. M. Olney, $48,591.50. In Ventura county, from the Santa Clara river to Ventura, 4 miles to be paved with concrete, Conner Construction Co., Los Angeles, $77,461.

Contract for grading and construction of concrete sidewalks on P street has been awarded to F. C. Cretser, 1115 I street, Sacramento.

Contract for improvement of 14th street has been awarded to F. C. Cretser.

Contract for construction of state highway in Los Angeles county between Castaic and Castaic school has been awarded to Brashear-Burns Co., Hollywood, for $28,093.30.

Contract for construction of state highway in Santa Barbara county from Las Cruces to Gaviota Pass has been awarded to Ira Hodson, San Luis Obispo, for $59,949.83.

Contract for construction of state highway near Santa Rita in Alameda county has been awarded to Bates, Borland & Ayer, Oakland, for $29,306.

SALT LAKE CITY, UTAH.—Bids will be received until 10 a.m., June 19, by Gordon Snow, city recorder, for improvement of several streets.

Election has been called for June 26 to vote on bond issue of $1,500,000 for street improvements, storm-sewers, and extension of water system.

SAN DIEGO, CAL.—Contract for improvement of Quince street has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $3893.10.

SAN FRANCISCO, CAL.—Bids will be received until 10:30 a.m., June 8, by Board of Public Works for grading, paving, and concrete work for Daniel Webster and Fairmount schools.

J. G. Harney, Pacific Bdg., San Francisco, was low bidder at $6340.20 for improvement of 47th avenue.

SAN LEANDRO, CAL.—Contract for construction of bituminous concrete pavement on plaza has been awarded to Johnson-Shea Co., Central Bank Bdg., Oakland.

SANTA BARBARA, CAL.—Bids will be received until noon, June 7, by A. C. Hall, city clerk, for grading and construction of asphalt pavement and concrete curbs and gutters on several streets.

Contract for improvement of several streets has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $84,516.

SANTA PAULA, CAL.—Contract for improvement of several streets has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $53,000.

SEAL BEACH, CAL.—Contract for construction of 4-in. concrete pavement with asphaltic surface on several streets has been awarded to Pearson & Summers, 2112 South Grand avnue, Los Angeles, for $8085.33.

SEATTLE, WASH.—Contract for improvement of Occidental avenue and other streets has been awarded to McGuire Bros., Seattle, for $73,315.

SHELTON, WASH.—Bids will be received until June 4 by I. W. Richardson, county auditor, for construction of permanent highway No. 4, 1½ miles of highway between Hoodsport and Potlatch, and the east end of the Ashley road.

SUNNYSIDE, WASH.—Contract for construction of bitulithic pavement on several streets has been awarded to Warren Construction Co., Portland, for $62,269.

VENTURA, CAL.—Contract for asphaltic surfacing on 4½ miles of concrete-paved county highway has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., Los Angeles, for $16,040.

Contract for construction of 1.74 miles of concrete highway at Saticoy has been awarded to Andrew Holloway, 471 South Broadway, Pasadena, for $9416.30.

Contract for construction of concrete-paved highway from Somis to Camarillo has been awarded to C. H. Hudson, Los Angeles, for $14,100.

VISALIA, CAL.—Specifications and general plans for the 50 miles of concrete highway, bids for which are to be received by the county clerk on June 5 and 6, are now on file at the office of 'Western Engineering'.

WATTS, CAL.—Bids will be received until 8 p.m., June 5, by city clerk, for paving Main street.

T. H. Heinauer, Watts, was low bidder at $22,809.86 for improvement of Main street.

YUMA, ARIZ.—Bids will be received until 5 p.m., June 12, by E. W. Dahl, city clerk, for construction of bitulithic pavement on several streets. Estimated cost is $80,000.

SEWERS AND DRAINAGE

LOS ANGELES, CAL.—Board of Public Works will receive bids until 10 a.m., June 4, for construction of sewers on 69th street, Crocker street, and 9th street.

RICHMOND, CAL.—Bids will be received until 8:30 p.m., June 4, by A. C. Faris, city clerk, for construction of 6-in. sewers on several streets.

SACRAMENTO, CAL.—Contract for construction of sewers on several streets has been awarded to J. W. Terrell.

SALINAS, CAL.—Bids will be received until 2 p.m., June

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28, by Henry Bardin, secretary reclamation district No. 1665, for construction of 38 miles of drainage ditches, requiring about 304,800 cu. yd. excavation. Plans from Lou G. Hare, Salinas City Bank Bdg., Salinas, upon deposit of $10.

SALT LAKE CITY, UTAH.—Bids will be received until 10 a.m., June 19, by Gordon Snow, city recorder, for construction of sewers on several streets.

SANTA BARBARA, CAL.—Bids will be received until noon, June 7, by A. C. Hall, city clerk, for construction of 6-in. sewers on Walnut avenue and on Anapamu street.

STOCKTON, CAL.—Following bids were received for construction of sewer on El Dorado avenue: Chambers & Heafey, Oakland, $3495.68; F. C. McIntire, $3879.63; W. F. Edwards, $4453.70; Tibbitts-Pacific Co., $6441.22.

TERRY, MONT.—Bids will be received until June 6 by D. C. Bradley, town clerk, for construction of sewer-system.

BRIDGES AND CULVERTS

CLIFTON, ARIZ.—Bids will be received until 8 p.m., June 25, by M. Danenhauer, city clerk, for construction of reinforced concrete bridge over San Francisco river. Plans from A. J. Kerr, city engineer, upon deposit of $5.

COLVILLE, WASH.—Bids will be received until June 9 by Earl T. Gates, county auditor, for construction of wooden bridge across Colville river.

MARYSVILLE, CAL.—E. L. Cope, First National Bank Bdg., San Francisco, is preparing plans for combination steel and wooden bridge to be constructed across Feather river at Nicolaus. Estimated cost is $120,000.

SEATTLE, WASH.—Bids will be received until June 19 by county commissioners for construction of wooden bridge over Raging river.

VANCOUVER, WASH.—Bids will be received until June 8 by M. R. Haack, county auditor, for construction of 360-ft. bridge over Lewis river. Structure is to be either a wooden arch bridge or a combination wood and steel suspension bridge.

WASHINGTON, D. C.—Contract for construction of bridge at Nogales, Arizona, has been awarded to Lown & Woods, Nogales, for $7000.

WINLOCK, WASH.—Bids will be received until June 15 by A. L. Quillen, city clerk, for construction of bridge on Hinning street.

IRRIGATION AND WATER SUPPLY

CALIPATRIA, CAL.—Time of opening bids for construction of spillway and intake for Northend Water Co. has been postponed from May 28 to June 4.

EL CENTRO, CAL.—Bond issue of $2,500,000 for improvement of irrigation system has been voted in Imperial irrigation district.

LODI, CAL.—Formation of irrigation district containing 20,000 acres of land west of city is proposed. System of Stockton-Mokelumne Canal Co. will be purchased and extended. Total estimated cost is $300,000.

MALTA, MONT.—Contract for excavation and earth lining on the Nelson Reservoir South canal has been awarded to Rolla Barnes, Malta, for $8750.

MANTECA, CAL.—Board of directors of South San Joaquin irrigation district will receive bids until June 12 for construction of auxiliary dams at the Woodward reservoir.

SACRAMENTO, CAL.—State Reclamation Board has approved plans of Knights Landing Ridge drainage district for widening Knights Landing Ridge cut. Estimated cost is $200,000.

SAN RAFAEL, CAL.—Bids will be received until 8 p.m., June 7, by C. F. Whitaker, secretary Marin municipal water district, for the construction of the Alpine dam. Work includes 8000 cu. yd. class C concrete, 2000 cu. yd. class B concrete, and 13,750 cu. yd. class C concrete, 75 cu. yd. backfilling, 150 cu. yd. grout, 1000 lin. ft. grout-wells, 1000 lin. ft. grout-pipes, and hauling 122,000 lb. of machinery and castings to be furnished by district. Plans from secretary upon deposit of $5.

SANTA BARBARA, CAL.—Contract for relining and construction of roof over reservoir No. 3 has been awarded to E. H. Hancock.

WASHINGTON, D. C.—Contract for earthwork on Camas division of Flathead project of U. S. Reclamation Service in Montana has been awarded to Ball & Jaffe, Seattle, for $48,167.

WICKENBURG, ARIZ.—Bids will be received until 8 p.m., June 23, by H. P. Ward, city clerk, for construction of extensions to water system. Plans from clerk upon deposit of $10.

LIGHT, HEAT, AND POWER

RENO, NEV.—C. S. Burns, Kansas City, has reported that value of property of Reno Light & Power Co. is $567,164. It is proposed that the city purchase the property and spend $764,090 in addition on improvements, including filter-plant.

WICKENBURG, ARIZ.—Bids will be received until 8 p.m., June 23, by H. P. Ward, city clerk, for construction of electric-lighting system. Plans from clerk upon deposit of $10.

RIVER AND HARBOR WORK

RIVERSIDE, CAL.—Highway Construction Co., Highland, has been awarded contract at $4900 for construction of bank-protection at Whitewater point.

SACRAMENTO, CAL.—Bond issue of $1,000,000 for completion of levees has been voted in reclamation district No. 1000.

RAILROAD WORK

PORTLAND, ORE.—Contract for clearing and grading ten miles of Gales Creek & Wilson River Railroad has been awarded to I. J. Roster and Arthur Porter. Contract for bridgework has been awarded to Interstate Bridge Company.

SAN FRANCISCO, CAL.—Contract for reconstruction of Nevada, California & Oregon Railroad between Chilcoot and Reno has been awarded to Utah Construction Co., Phelan Bdg., San Francisco, by the Western Pacific Railway.

BUILDING CONSTRUCTION

ANDERSON, CAL.—Bond issue of $40,000 for construction of high-school building has been defeated.

ASTORIA, ORE.—Standard Oil Co. will construct distributing-station. Estimated cost is $150,000.

BAKERSFIELD, CAL.—San Joaquin Valley Sugar Co., Visalia, will erect sugar-factory. Estimated cost is $1,000,000.

CORVALLIS, ORE.—Contract for construction of library building for Oregon Agricultural College has been awarded to Snook & Traver, Salem, for $83,300.

ENTERPRISE, ORE.—Contract for construction of school building has been awarded to John Almeter, Portland, for $43,400.

EUGENE, ORE.—Bids will be received until 9 a.m., June 13, by L. H. Johnson, secretary board of regents of University of Oregon, for construction of women's dormitory. Lawrence & Holford, Chamber of Commerce Bdg., Portland, are architects.

GUINDA, CAL.—Bond issue of $10,000 for construction of school-building has been voted.

LAS VEGAS, NEV.—Bids will be received until noon, June 4, by county board of education for construction of concrete school-building. Wilson & Eager, Monrovia, Cal., are architects. Deposit of $20 required for plans.

MONROVIA, CAL.—Contract for construction of grammar-school building has been awarded to George A. Daniels, 916 Herkimer street, Pasadena, for $32,660.

OAKLAND, CAL.—Contract for plumbing at Piedmont school has been awarded to J. Rankin & Son, 566 18th street, Oakland, for $8963. Contract for plumbing at Lincoln school has been awarded to J. B. Cruz, 2632 Myrtle street, Oakland, for $11,150.

OROVILLE, CAL.—Plans have been completed and call for bids will be issued soon for reinforced concrete school building. Estimated cost is $60,000. N. W. Sexton & Co., Merchants National Bank Bdg., San Francisco, are architects.

PARLIER, CAL.—Contract for construction of packing-house for California Peach Growers, Inc., has been awarded to Johnson Bros., Kingsburg, for about $21,000.

SAN FRANCISCO, CAL.—Charles A. Haber, Monadnock Bdg., is preparing plans for brick and frame church-building to be erected at Bush and Taylor streets. Estimated cost is $50,000.

Contract for alterations and additions to building at Fremont and Market streets has been awarded to A. D. Collman, 110 Jessie street, San Francisco, for $17,355.

John Dempniak, 1664 Washington street, San Francisco, will construct brick apartment-house by day labor. Estimated cost is $30,000.

Reid Bros., California Pacific Bdg., San Francisco, have completed plans for addition to class A building owned by Barron estate. Estimated cost is $65,000. Contract for structural steel for this building has been awarded to Mortensen Construction Co., 19th and Indiana streets, San Francisco.

Following sub-contracts have been awarded for work on building for American National Bank at California and Montgomery streets: Structural steel to California Steel Co., Humboldt Bank Bdg. Terra cotta to Gladding-McBean Co., Crocker Bdg. Granite to McGillivray Raymond Co., 634 Townsend street. Reinforcing steel to Woods, Huddart & Gunn, 444 Market street. P. J. Walker Co., Monadnock Bdg., has general contract.

SAN JOSE, CAL.—Contract for construction of two-story

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building for Prune & Apricot Growers' Association has been awarded to Twohy Bros. Co., First National Bank Bdg., San Francisco.

SANTA BARBARA, CAL.—Bids will be received until June 4 by R. F. Sauter, architect, for construction of club-house for La Cumbre Golf and Country Club. Estimated cost is $15,000.

Bond issue of $275,000 for construction of high-school building has been defeated.

SPOKANE, WASH.—Sperry Flour Co., San Francisco, will construct flour-mill. Estimated cost is $125,000.

WALNUT CREEK, CAL.—Pacific Glove Co., Broadway and 15th streets, Oakland, will construct several brick and reinforced concrete buildings. Total estimated cost is $100,000. A. B. Benton, 114 North Spring street, Los Angeles, is architect.

WASHINGTON, D. C.—Contract for construction of buildings at Seward, Alaska, has been awarded to Gudebrod Bros. for $68,516.

Contract for construction of shell-house and laboratory at Mare Island, Cal., has been awarded to Lange & Bergstrom, Sharon Bdg., San Francisco, for $21,934.

Contract for construction of coast-guard station at Bolinas bay has been awarded to J. Eric Johnson. San Francisco, for $9988.

MACHINERY AND SUPPLIES

BERKLEY, CAL.—Standard Oil Co. bid $1.91 per bbl. and Union Oil Co., $1.80 for furnishing fuel-oil to city. Both bids were rejected.

CALEXICO, CAL.—Bids will be received until 7:30 p.m., June 5, by E. P. Green, city clerk, for furnishing a combination street-flusher and sprinkling-wagon, tank capacity about 600 gal., either horse-drawn or motor-propelled.

CENTERVILLE, CAL.—Contract for furnishing about six miles of 24-in. cement pipe for Graves Bros. has been awarded to Concrete Pipe & Construction Co., Porterville.

NAPA, CAL.—Bids will be received until 8 p.m., June 7, by Howard E. Roper, secretary of school board, for furnishing 55 tons of No. 1 lump-coal.

RICHMOND, CAL.—Contract for furnishing an automobile fire-engine to city has been awarded to Seagrave Co. for $9250.

SACRAMENTO, CAL.—All bids for furnishing cement for county highway work have been rejected and 40,000 bbl. of cement will be purchased in the open market.

County has purchased 30,000 bbl. of cement from Henry Cowell Lime & Cement Co. at $2.10 per bbl. net.

SAN BERNARDINO, CAL.—Board of water commissioners will receive bids until 4 p.m., June 4, for furnishing 800 ft. of 16-in. casing.

SANTA MONICA, CAL.—Bids will be received until 10 a.m., June 6, by city clerk, for furnishing a miscellaneous quantity of reinforcing steel and galvanized-iron roofing.

SEATTLE, WASH.—Bids will be received until 11 a.m., June 6, by C. E. Dole, purchasing agent, Alaskan Engineering Commission, for furnishing pipe and fittings, plumbing and heating supplies, boiler-tubes, electric flashlights and batteries, pump governor, and vacuum-pump. Particulars from circular No. 296, which may be obtained from office of commission, 514 Kohl Bdg., San Francisco.

Bids will be received until 11 a.m., June 8, by C. E. Dole, purchasing agent, Alaskan Engineering Commission, for furnishing cement, small tools, and hardware. Particulars from circular No. 298, which may be obtained from office of commission, 514 Kohl Bdg., San Francisco.

WASHINGTON, D. C.—Bureau of Supplies and Accounts will receive bids until June 12 for delivery at Mare Island, Cal., of one motor truck, schedule 1171. Particulars from Purchasing Pay Officer, U. S. Navy Pay Office, San Francisco.

Bids will be received until 10:30 a.m., June 15, by general purchasing agent, The Panama Canal, for furnishing hardware and electrical supplies. Particulars from circular No. 1147 which may be obtained from assistant purchasing agent, Fort Mason, San Francisco.

MISCELLANEOUS

BERKELEY, CAL.—Contract for placing asphalt surface on tennis-courts for Berkeley Tennis Club has been awarded to Clark & Henery Construction Co., Oakland.

NEWPORT BEACH, CAL.—Contract for construction of board sidewalks on piling along ocean front has been awarded to Fred Hoffman, Long Beach, for $3.25 per lin. ft. Other bidders were: Glenn Helms, $3.34; Edgar T. Wheeler Co., $4.27; Johnson-Shea Co., $4.40; Harvey Garber, $5.62.

OAKLAND, CAL.—Bids will be received until noon, June 14, by L. W. Cummings, city clerk, for sweeping streets, repairing asphalt pavements, oiling street-surfaces, and collecting garbage during year ending June 30, 1918.

ONTARIO, CAL.—Bids will be received until 7:30 p.m., June 4, by R. O. Brackenridge, city clerk, for drilling a well.

PORTLAND, ORE.—Contract for furnishing 300 freight-cars for Southern Pacific Co. has been awarded to Twohy Bros. Co., Portland.

SAN FRANCISCO, CAL.—Contract for construction of 12 submarines for Federal Government has been awarded to Union Iron Works.

SAN RAFAEL, CAL.—Bids will be received until 8 p.m., June 4, by E. W. Smith, city clerk, for removal of old fire-alarm system.

Building Permits

In SAN FRANCISCO; $2500 and over in valuation.

MAY 24

TWO STORY FRAME APARTMENTS—Cost $20,000. L. B. Ham, owner. SE Arguello Blvd and Euclid Ave.

MAY 25

SHOP BUILDING ADDITION—Cost $4000. J. B. Reite, owner. 1445 Bush.

ONE STORY BRICK FACTORY AND STORE—Cost $9300. Jos. Eastwood, owner. N Howard 100 E Fremont.

MAY 26

TWO STORY FRAME RESIDENCE—Cost $10,500. Allen & Co., owner. N El Camino Del Mar 243 E 32nd Ave.

ONE STORY BRICK PRIVATE GARAGE—Cost $15,000. McCreery Estate, owner. N Brannan 420 E 5th.

MAY 28

TWO STORY FRAME FLATS—Cost $9900. Amedeo Costa, owner. N Union 100 W Taylor.

STORAGE AND OFFICE ROOMS ALTERATIONS—Cost $2557. Logan Caldwalder, owner. NW Sutter and Van Ness Ave.

TWO STORY FRAME DWELLING—Cost $2500. F. Nelson & Sons, owners. E Hill Point 30 N Parnassus Ave.

TWO STORY FRAME DWELLING—Cost $2500. F. Nelson & Sons, owners. E Hill Point 55 N Parnassus Ave.

TWO STORY FRAME DWELLING—Cost $2500. F. Nelson & Sons, owners. E Hill Point 80 N Parnassus Ave.

TWO STORY FRAME DWELLING—Cost $2500. F. Nelson & Sons, owners. E Hill Point 105 N Parnassus Ave.

THREE STORY FRAME APARTMENTS—Cost $30,000. Wm. G. Gilmour, owner. SE Leavenworth and Washington.

MAY 29

ONE STORY FRAME DWELLING—Cost $2870. C. B. Way, owner. W Eastwood, Lot 12 Block 3176.

ONE STORY FRAME DWELLING—Cost $2710. W. W. Van Volkenburgh, owner. N Southwood, Lot 9 Block 3189.

NOTICE TO CONTRACTORS

Notice is hereby given that sealed proposals will be received by the Board of Trustees of Reclamation District No. 1665 of the State of California, at its office in Salinas City, Cal., until 2 p.m. of the 28th day of June, 1917, said proposals to be enclosed in sealed envelopes endorsed "Proposals for Canal Excavation" and addressed to Henry Bardin, Secretary, Salinas City, Cal.

All proposals must be made upon blank forms to be obtained of Lou G. Hare, Chief Engineer, at his office in Salinas City Bank Building, Salinas City, Cal., and signed by the bidder with his address.

Each bid shall be accompanied by cash or a certified check made payable to the President of the Board of Trustees of said Reclamation District in an amount equal to ten per cent of the bid, and no bid will be considered unless accompanied by such cash or check; said cash or check to be forfeited if the bidder depositing the same and to whom the contract is awarded shall fail to sign and deliver his contract within ten days after notice that it has been awarded to him has been mailed to his address.

A bond in a sum not less than one-fourth and not greater than one-half of the estimated cost of the work as per the specifications therefor, conditioned for the faithful performance of the contract, will be required, and a further bond in a sum not less than one-half of the cost as estimated in said specifications and conditioned for the payment of material, mechanics and laborers, etc., as required by the Act of March 27, 1897, and Acts amendatory thereof will also be required to be given by the successful bidder.

The work to be done comprises the construction of about 38.32 miles of main canal, laterals, and sub-laterals and the necessary excavation, estimated at approximately 304,800 cubic yards, and all bids are to be compared on the basis of the Chief Engineer's estimate of the quantities of work to be done.

The foregoing estimated quantities are approximate only and the Reclamation District does not agree that the actual amount of work will correspond therewith, but the right is reserved to the Board of Trustees to increase or decrease the amount of any class of portion of the work as to them may seem necessary or expedient.

Bids are desired only from reliable and experienced contractors in this character of work, and in the award of contract great consideration will be given to the reliability of the bidder and his probable ability to complete the work in a proper manner and on time, and the contract will not necessarily be awarded to the lowest bidder, the Board reserving the right to reject any and all bids.

Plans, specifications and form of contract may be seen at the office of Lou G. Hare, C. E., Salinas City Bank Building, Salinas, Cal., and on and after May 21st copies thereof may be obtained on deposit of $10 per set, the deposit to be refunded upon return of set in reasonably good order.

RECLAMATION DISTRICT NO. 1665.
HENRY BARDIN, Secretary.

Salinas City, California.

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